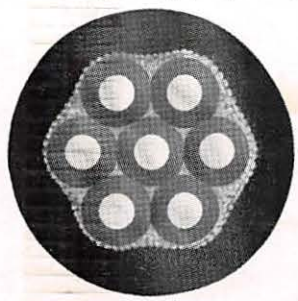
OCTOBER 1968

Railway Signaling & Communications

on guard... in nuclear plants

This is an end view of the source chamber section of a mass spectrometer. The instrument identifies and counts the isotopes in analyzing samples of atomic fuels. White heat reduces the samples to an ionized gas. Measurement of the beam's intensity indicates the quality of the fuel. Specially engineered cladding provides the very utmost in protection.

Below is an end view of a Kerite cable. This design is based on long-term research and field performance. It utilizes materials which have compiled successful service records and, in addition, have demonstrated great resistance to radiation, heat and fire. All Kerite cables recommended for nuclear plants provide uniformly high electrical integrity for important circuits in both normal and incident conditions. The Kerite Company · Principal Offices: New York; Chicago; Seymour, Connecticut · Sales Representation Throughout the United States.

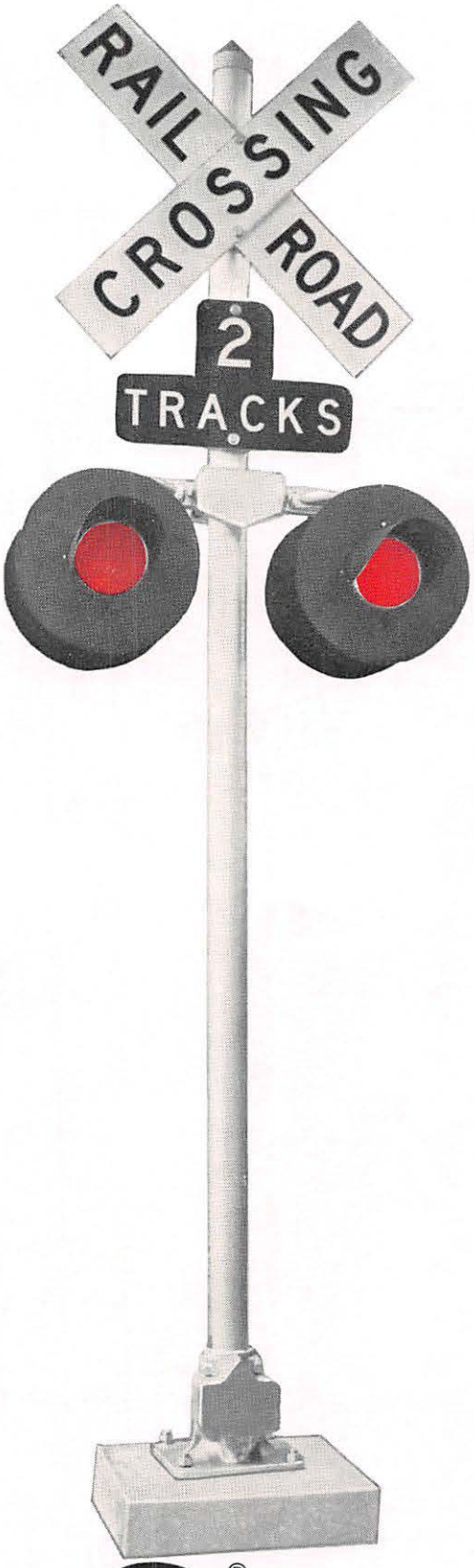


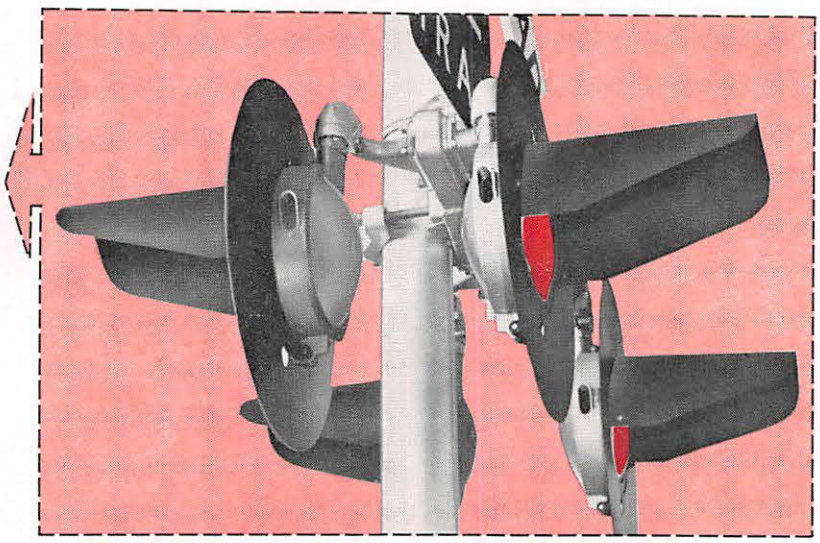
MEMBER RPI Kerite

the cable that lasts...and lasts...and lasts...

Simmons-Boardman **TIME-SAVER** Publication

RACO®
ALUMINUM
FLASHING LIGHT SIGNALS
WITH FLX-10 LIGHTS





Teamed to provide the optimum in Highway Crossing Protection

ALUMINUM offers greater resistance to corrosion . . . reduces painting and maintenance costs. Easier to handle, install, maintain and cuts shipping costs too! Keeps original appearance month after month.

Lamp unit assemblies and crossarms are cast aluminum . . . interchangeable with all AAR standard units now in service.

DESIGNED FOR MINIMUM MAINTENANCE . . . LONG SERVICE LIFE

High impact Plastic Lenses provide high optical efficiency and hold breakage (from any cause) to a minimum.

The FLX-10 LIGHT SIGNAL UNIT is ideal in combination with the RACO Aluminum Cantilever Flashing Light Signal with swinging boom . . . greater visibility . . . easier servicing.

For complete details, contact:

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RACO PRODUCTS ® ENGINEERED FOR LONG LIFE

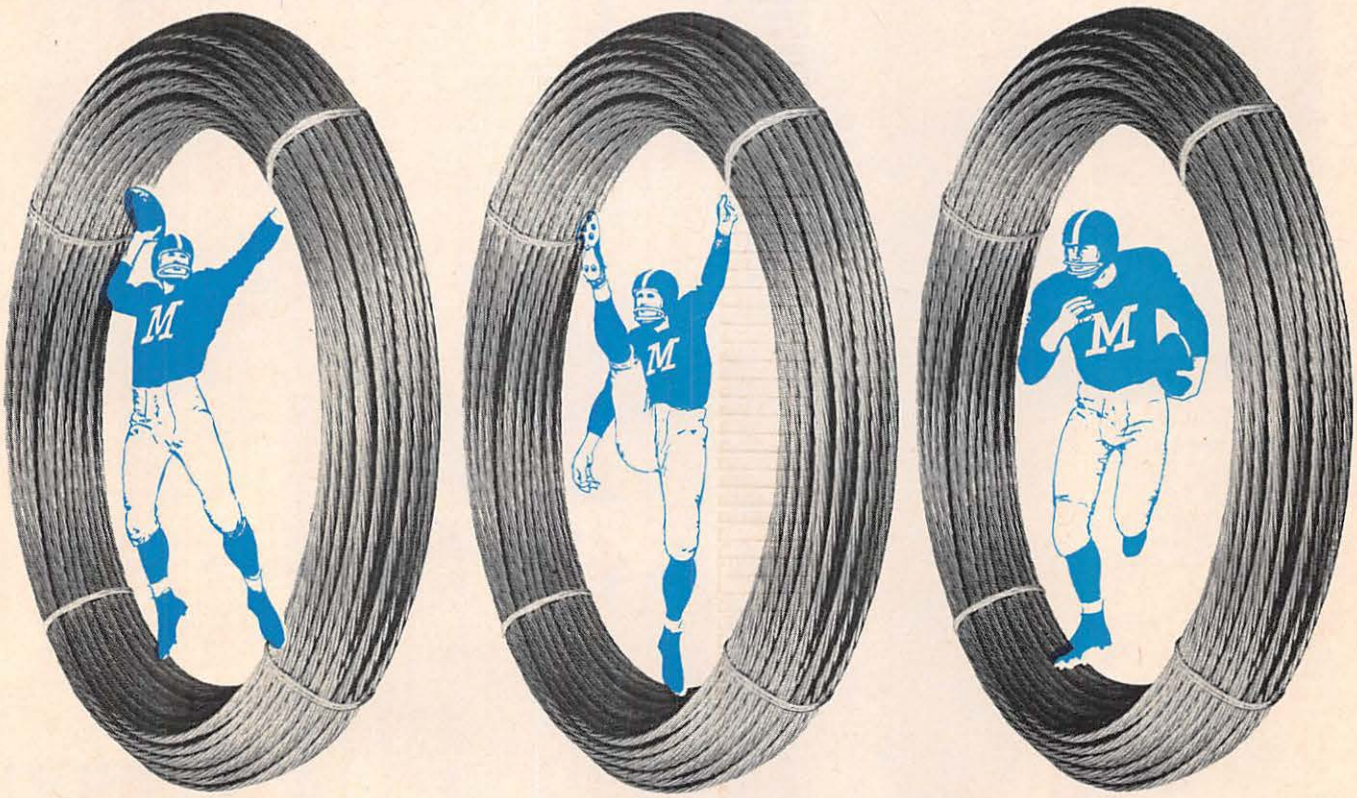
Railroad Accessories Corporation

Main Office and Plant: 4650 MAIN STREET N.E., MINNEAPOLIS, MINN. 55421
Office and Plant: 7615 NATIONAL TURNPIKE, FAIRDALE, KY. 40118

IN CANADA: Vale Enterprises, Ltd., 1120 Claire Crescent, Lachine, Quebec

Circle 1 on reader service card on page 42

TRIPLE-THREAT GUY



LOW FIRST COST | NO MAINTENANCE COST | NO REPLACEMENT COST

You'll be a fan of today's ALUMOWELD® Type M® Guy Strand when you see how much it can save you!

A real triple-threat performer, today's Alumoweld® Type M® guy strand scores high on three important savings. You save on first cost, on maintenance, and on replacement.

You know about the lasting strength of Alumoweld, protected by a permanent pure aluminum cladding that is thicker than the protective jacket on any other aluminum-covered or any zinc-covered steel wire. You know that it never needs maintenance, never needs to be replaced.

But do you know about the extra savings possible with today's Alumoweld Type M guy strand? Its low first cost will surprise you. So will the installation savings it makes possible because it is lighter than any other high-strength guy strand, is easier to handle, goes up faster.

If you are interested in saving money, you owe it to yourself to find out exactly how much you can cut guying costs with Alumoweld Type M guy strand. Ask to have one of our sales engineers call on you, or write us for more details.

World Leader in Bimetallic Wire

COPPERWELD STEEL COMPANY

WIRE AND CABLE DIVISION, GLASSPORT, PA. 15045

For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

ALUMOWELD® Type M® Guy Strand

FOR FAST WAREHOUSE SERVICE, contact our offices in New York, Chicago, Pittsburgh, Memphis and San Francisco. Stocks also available from warehouses of leading distributors.

Circle 4 on reader service card on page 42

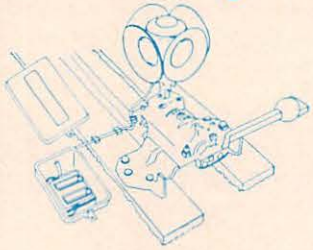
EDISON
Carbonaire
BATTERY
Type 2-S-J-1
Rated capacity:
1000 a.h.

EDISON
Crystalaire
BATTERY
Type F
Rated capacity:
1300 a.h.

EDISON
Carbonaire
BATTERY
Type 2-S-L-2
Rated capacity:
1200 a.h.

only Edison offers switch lamp batteries with capacities of 1000 a.h., 1200 a.h. AND 1300 a.h.

for greater flexibility of battery change-out time



BATTERY LIFE TABLE FOR SWITCH LAMP LIGHTING					
TYPE OF BULB			APPROX. LIFE OF ONE BATTERY ON CONTINUOUS DISCHARGE		
VOLTS	AMPS.	STYLE	TYPE 2-S-J-1 CARBONAIRE	TYPE 2-S-L-2 CARBONAIRE	TYPE F Crystalaire
2.9	.150	INFRO-S.C.*	10 MONTHS	1 YEAR	13 MONTHS
3.5	.120	INFRO-S.C.*	1 YEAR	14 MONTHS	15 MONTHS

*SINGLE CONTACT, BAYONET BASE

Write for complete details

MEMBER RPI

THOMAS A. EDISON INDUSTRIES
PRIMARY BATTERY DIVISION • BLOOMFIELD, N. J. 07003

McGRAW EDISON

Circle 5 on reader service card on page 42

October 1968
Vol. 61 No. 10

Railway Signaling & Communications

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Editor's Corner

That the AAR is moving ahead with its TRAIN project, there is no doubt. It will be operational in late 1969 or by 1970. That 1970 date is important for that is when all cars and motive power units moving in interchange will have to be equipped with ACI labels. Certainly the time is now for C&S men to get working on the implementation of these projects for their railroads.

"The AAR could properly serve the industry as a clearinghouse for data of all kinds. We have no wish to impose our will. We only want to be asked to lead, to guide, to give direction to a cooperative effort," stated AAR's President, Thomas M. Goodfellow, at last month's Data Systems Division annual meeting. It's coming through the implementation of the Tele-Rail Automated Information Network, or TRAIN that will be fully operational in 1970.

Initial hardware including an IBM 360/40 is scheduled to be installed in AAR's new Washington headquarters building this December. Systems, procedures and programming are now underway with the goal of scheduling for tests with a few railroads in July 1969. When ACI labeling is complete in January 1970, all participating roads (about 60) will be in the TRAIN system.

AAR will use three outward WATS lines for calling the TRAIN terminal equipment on each railroad. TRAIN computer will dial around to each road about once every hour. If roads have interchange delivery data in the transmitters of their data terminal units, it will be sent to the computer. Railroads will be able to make inquiries via these same terminals, but the TRAIN computer will do the calling. Speed of response will be initially dependent upon the availability of a WATS line.

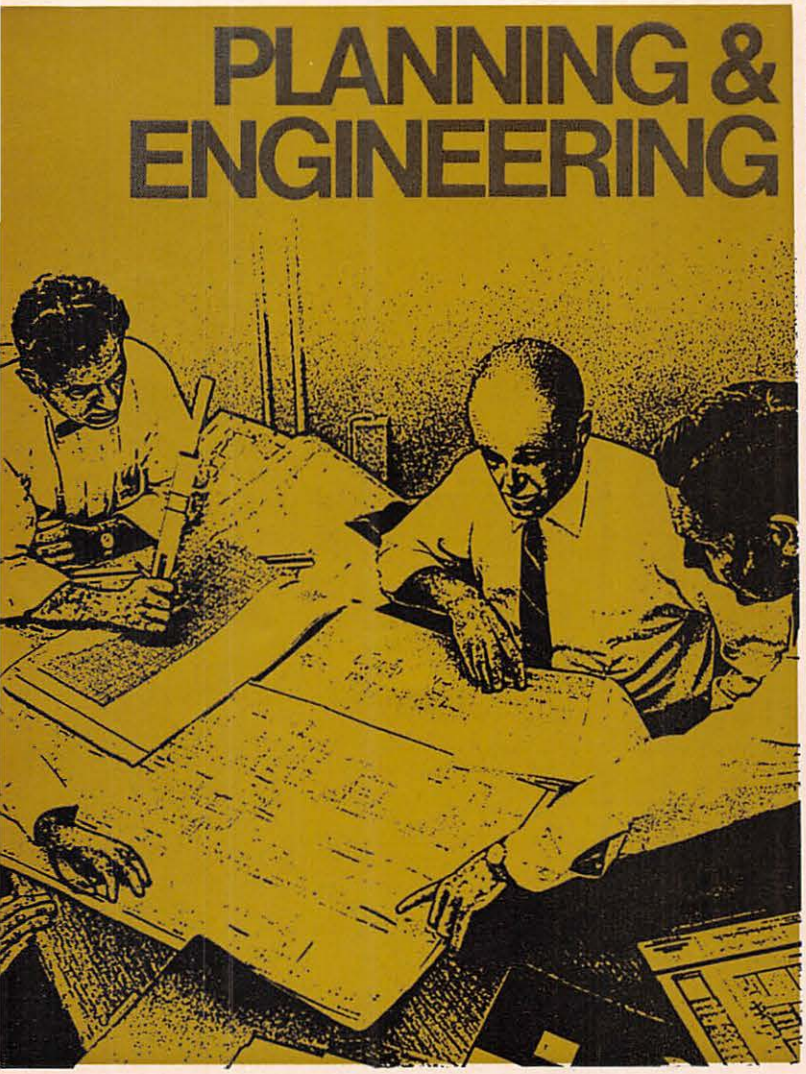
The TRAIN system will handle 180,000 cars involved in about 5,000 to 6,000 interchange moves. TRAIN computer is expected to receive 200 messages daily.

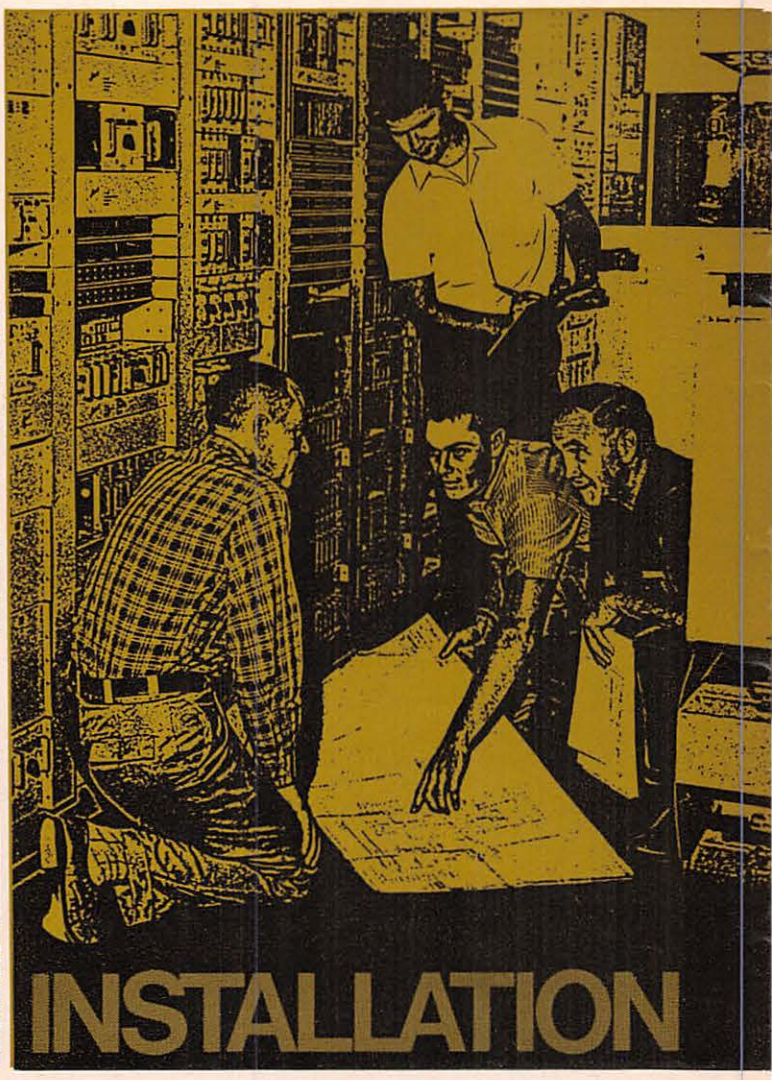
Terminal equipment used will include IBM 1050s, AT&T's TWX and Data Speed units, and Western Union's Telex service. Magnetic tape units may be used by large railroads. The terminal equipment used will depend upon the size of the railroad or number of cars interchanged that it will be reporting.

It is planned to batch process once per day the interchange data sent to the TRAIN computer. The initial goal or what may be called phase one of the operation will be to satisfy AAR's Car Service Division requirements for a timely, accurate car inventory. However, the computer will be programmed to answer inquiries from railroads participating in the TRAIN project.

Bob McKnight

The Lenkurt total





When you decide on a Lenkurt system—whether it's microwave, radio multiplex, cable carrier, open wire carrier, telegraph, or data transmission—you can expect more than just the most complete telecommunication product line on the market.

You can expect a lot of service. We'll analyze your present and future needs; plan the best system for you in detail; handle all stages of installation; provide a free, continuing program of formal instruction for your employees at our factory.

You can expect a lot of experience. The kind that comes from years of serving your industry; the kind a company can give you when its primary business

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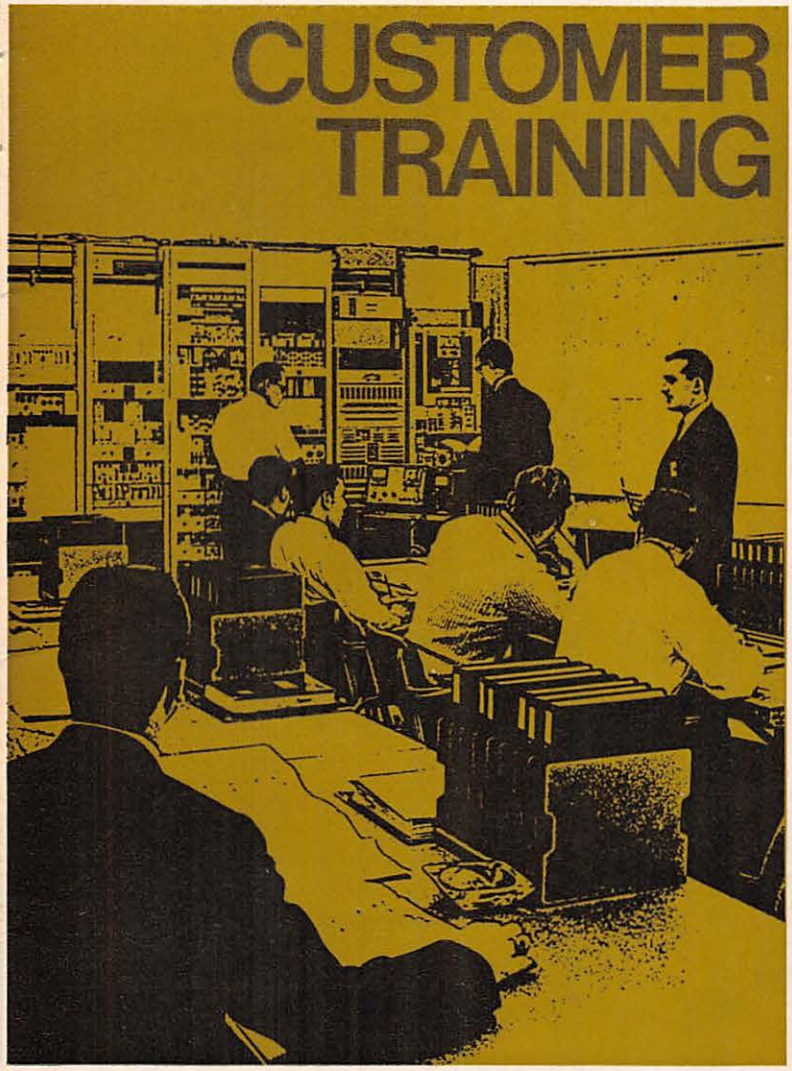

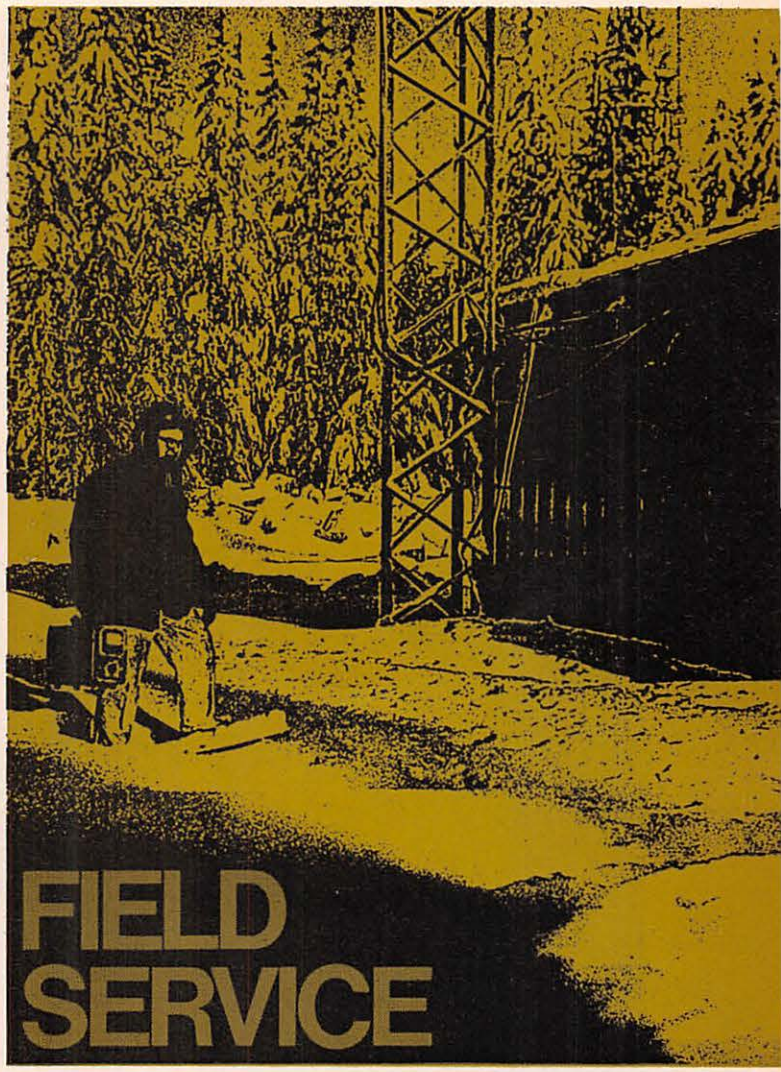

is the telecommunication business; the kind you get when a company was the first to offer engineering, planning, and installation services.

You can expect equipment that's built better, that's easier to operate and maintain than similar products; that's designed not only for your present application, but for your future growth.

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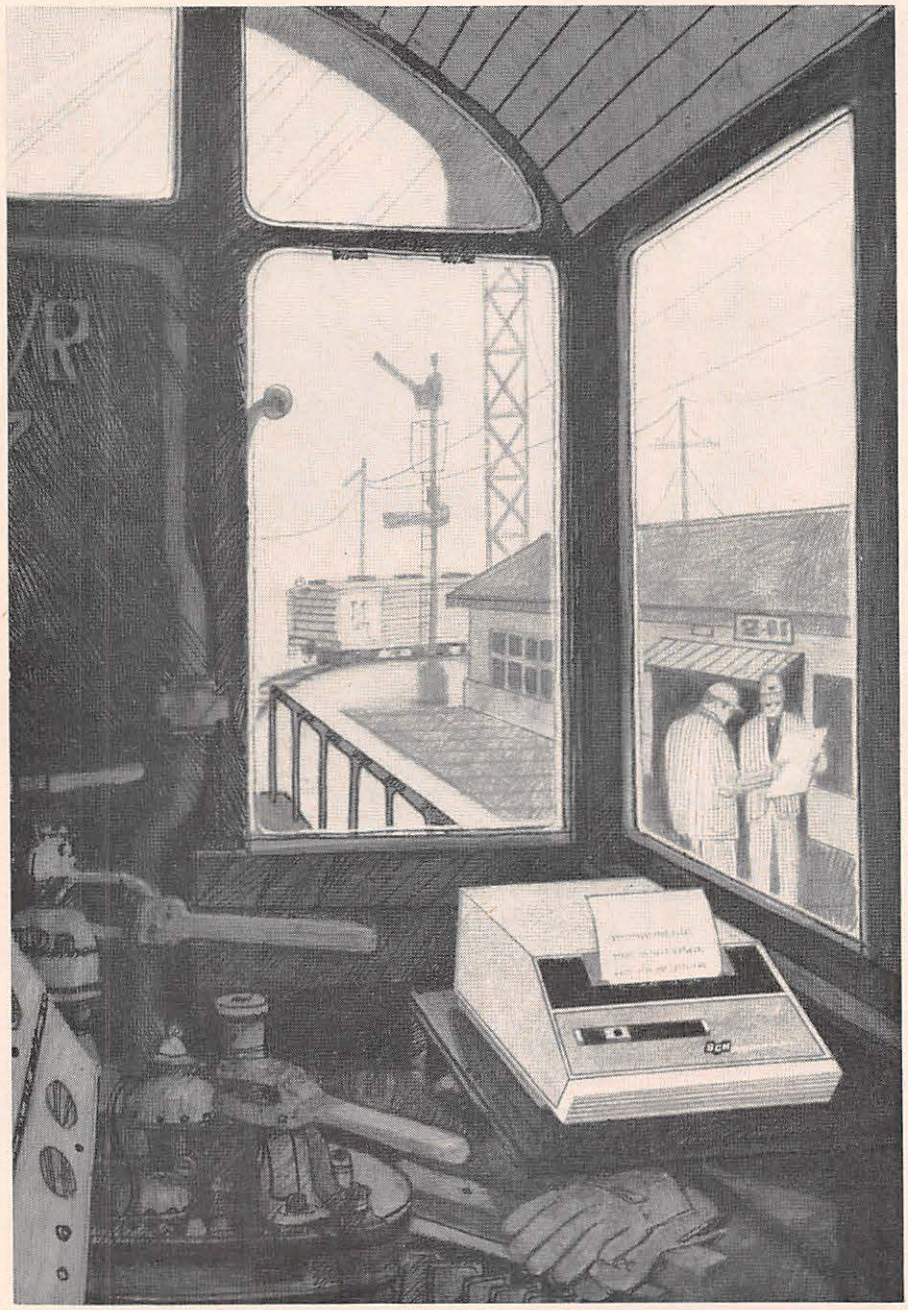
LENKURT ELECTRIC
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Circle 6 on reader service card on page 42

Get the message even when you leave your cab– because it's printed!

The new Kleinschmidt Telescripter,™ first radio printer designed for railroads. Compact, plug-in, static-free.



Step away from your engine with a Kleinschmidt Telescripter printer in the cab and you don't have to worry. When you come back, you'll find all your calls waiting. *Printed.*

With a Telescripter printer at work, a busy train crew can concentrate on moving freight and let the machine take the messages.

A Telescripter prints-out complicated instructions in seconds, even when the train is in motion. Time designations. Track numbers. Car numbers. Freight sequence. Everything the crew needs to know is there, error-free, on paper.

In a caboose, a Telescripter printer gives the crew a hard-copy record of all destinations and orders automatically. So there can be no misunderstanding.

A Telescripter train unit plugs easily into any two-way radio. And because the messages are printed, they're always free of static and interference.

Most important, the Telescripter printer is designed with Kleinschmidt quality for extra reliability and sure performance.

For full details on the amazing new Kleinschmidt Telescripter printer, write to Kleinschmidt, Division of SCM Corporation, Deerfield, Ill. 60015. Telephone 312-945-1000.

KLEINSCHMIDT
DIVISION OF SCM CORPORATION

SCM®

Circle 7 on reader service card on page 42

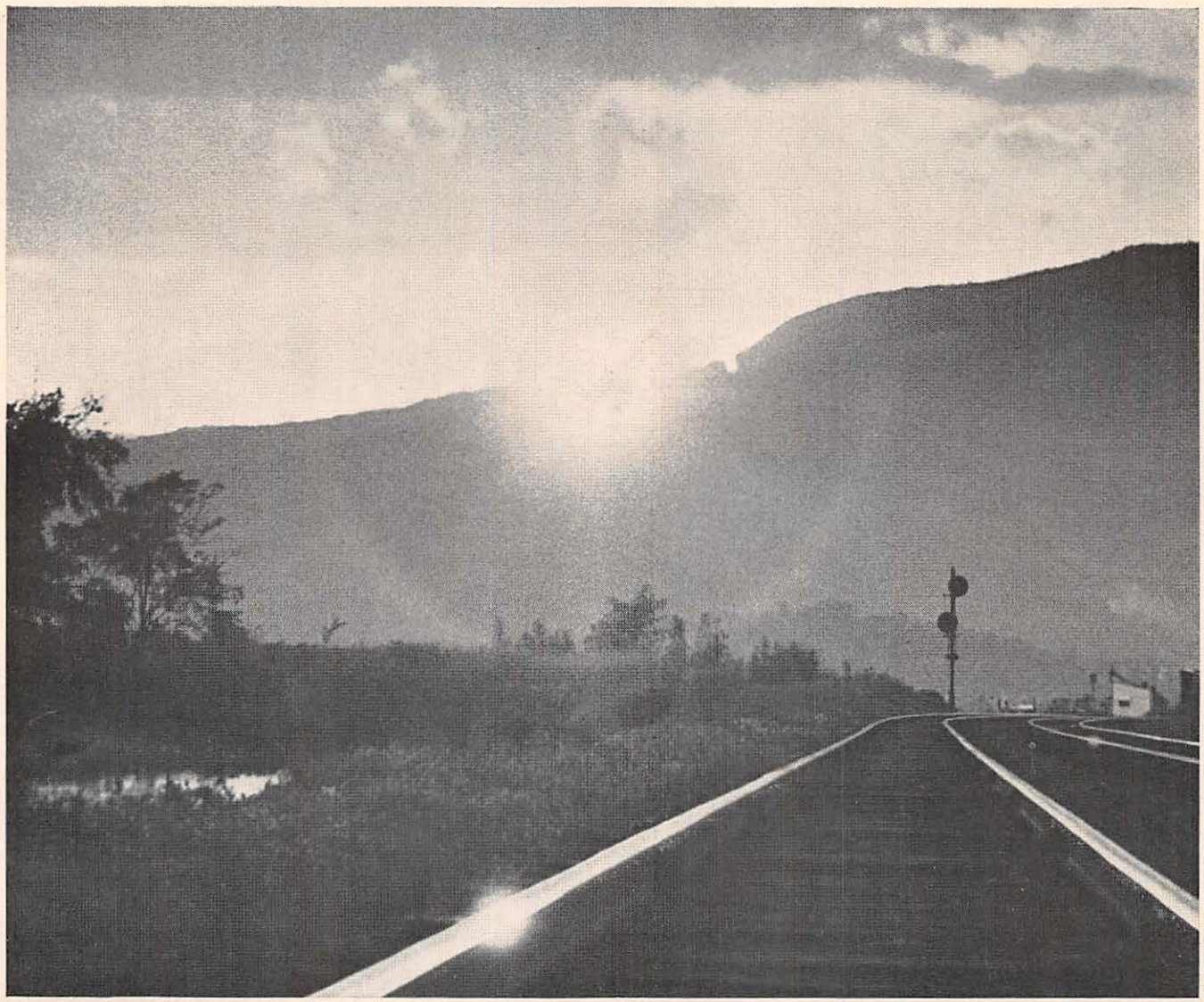
No poles. No towers. No antennas. Nothing to mar Mother Nature. Reason? It's a revolutionary approach to railroad cable systems . . . developed by Cable Communication Systems, Inc. . . . that puts everything out of sight, underground. It combines greater simplicity, proven performance, high reliability, versatility, and high channel capacity with low maintenance, low cost operation. In short, everything you look for in the ideal communication and signal system. And . . . it's compatible with C.C.I.T.T. and Bell System standards.

A CCS railroad cable system is the best way to combine and up-date your signal and communication operations to handle your ever-increasing volume of signal, voice and data transmission traffic. It eliminates high monthly leasing fees. It can be buried along your present right of way. No worry about new easements, land acquisition, or site clearance problems. The CCS way side-steps local, state and federal red tape. Another advantage — a CCS buried coaxial cable system is not affected by transient ambient conditions.

CCS railroad cable systems can be supplied as complete turnkey installations with expandable capacity from 120 to 1260 voice channels. A typical CCS cable system includes terminal stations, extraction stations, line repeaters, signal circuits and coaxial cable. The coaxial employs the unique Cap-Cel™ air dielectric coaxial construction. The line repeaters, terminal and extraction equipment are all solid state design for high reliability, light weight, and low power consumption. Modular construction is used throughout to permit greater flexibility and to keep costs low.

For more information on how a CCS railroad cable system can give your road "years ahead" communication and signal capability, write: Cable Communication Systems, Inc., 79 Sidney Street, Cambridge, Massachusetts 02139. Or call: (617) 547-9000.

You're looking at a new concept in railroad communication and signal systems



Cable Communication Systems, Inc. is a jointly owned company utilizing the technologies of the Simplex Wire and Cable Company and CIT-Compagnie Industrielle des Télécommunications, a subsidiary of CGE-Compagnie Générale d 'Eléctricité.

CABLE COMMUNICATION SYSTEMS, INC., 79 Sidney St., Cambridge, Mass. 02139

Circle 18 on reader service card on page 42

Wherever you need dependable power
...You need FANSTEEL

■ Fansteel's complete line of rectifier products—ranging from track rectifiers to sophisticated standby power systems—assures you of dependable railway signal and communications system operation under all conditions. You can select from more than 1000 service proved units. All meet existing AAR standards and give you longer operating life, more reliable performance and lower maintenance costs. These include: ■ Constant Potential Battery Chargers—completely automatic units designed especially for unattended operation. ■ Model DL Automatic Battery Chargers—ideally suited for railway signal operations where load and temperature conditions are irregular. ■ Model DT Selenium Rectifiers—the original selenium rectifier for signal service. ■ Static SCR Inverters—which assure emergency AC standby power for communications and signaling systems. Also DC to DC converters. And, Fansteel offers immediate delivery of most signal rectifiers and battery chargers. You'll be ahead to add Fansteel reliability to your system. For detailed facts on any of these units, write today.

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Rectifier Products

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NUMBER ONE TANTALUM PLACE
NORTH CHICAGO, ILLINOIS 60064

These same products will be manufactured by Power Conversion Products, Inc., formerly the Rectifier Products Division of Fansteel Inc.

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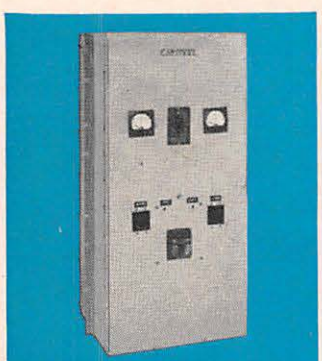
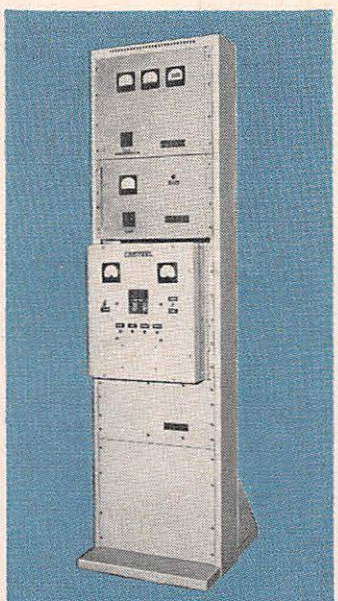
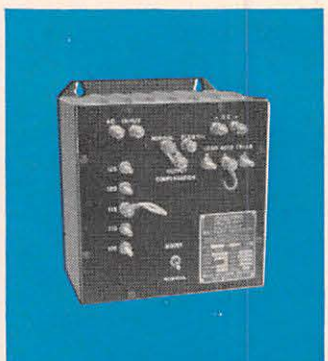
Fansteel Selenium Signal Rectifiers are warranted against aging and defective workmanship for 10 years.



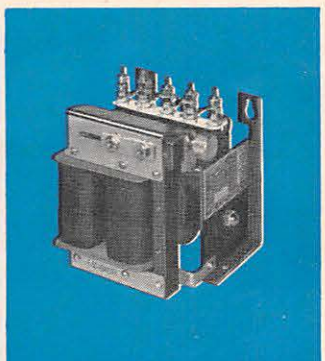
Constant Potential Battery Charger



Static SCR Inverter shown in Standby Power System

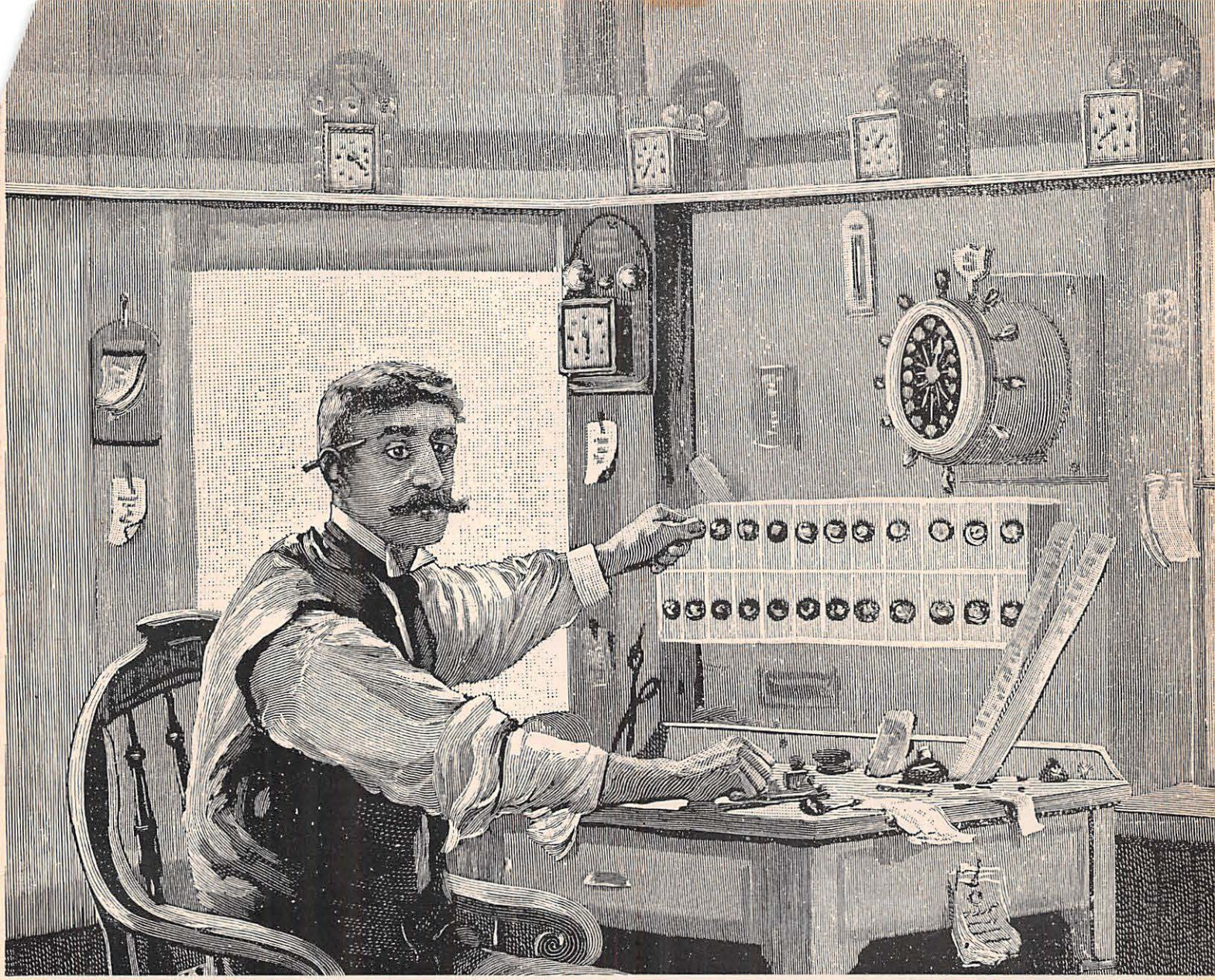


Model DL Automatic Battery Charger



Model DT Selenium Rectifier

Circle 9 on reader service card on page 42



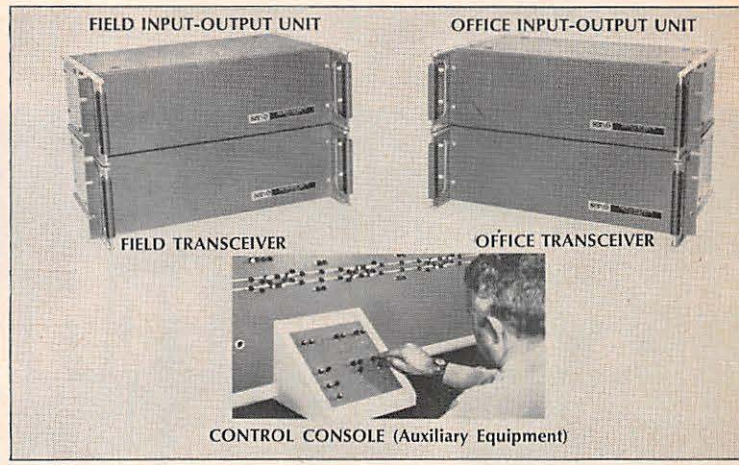
"Land sakes! What do they expect from one man? I told 'em I need a new Servoscan remote control system to handle all this traffic!"

SOUND familiar? The problem of efficient control of railroad operations hasn't really changed since 1888—it's just gotten worse. Today, railroad men face an ever-increasing array of new and more demanding competitive requirements—as well as the always-present factor of high labor costs.

To help railroads and rail transit operators achieve a greater degree of automation and economy, we've developed SERVOSCAN™, a new high speed solid state remote control system with self-checking reliability. SERVOSCAN is applicable to any multiple station installation that requires *control* of remote "ON-OFF" apparatus and *indication* (or monitoring) of remote "ON-OFF" contacts. Typical uses include centralized traffic control, multi-station interlockings, route check networks, classification yards, etc.

The integrated circuit design of SERVOSCAN makes it smaller, more reliable and less costly than equivalent non-vital relay equipment. A provision for manual stepping greatly simplifies field maintenance and checkout. Standard SERVOSCAN models are available to accommodate up to 64 remote field stations. A wide variety of control systems with different capacities can be easily assembled by merely stacking individual standard units.

Looking for a reliable and economical new way to improve your control system? Take a tip from our old friend, the 1888 dispatcher—take a look at SERVOSCAN. Just ask for Tech Data Publication 2006.



SERVOSCAN™ Remote Control System consists of four basic units: office transceiver, office input-output, field transceiver, and field input-output. Each unit measures only 5¼" x 11" x 17". Communication between office and field stations is by FSK carrier using return-to-zero coding. Auxiliary equipment is available from Servo on a custom-design basis, including control and display consoles, tape readers, solid state route check networks, manual local control panels, etc.

SERVO SYSTEM SERVICE—Servo Corporation of America backs up its railroad products with complete support and assistance—site survey, application engineering, detailed proposal, installation checkout, plus lifetime service and personnel training—all provided at no extra charge!

servo corporation of america

servo

railroad products division
111 new south road
hicksville, n.y. 11802
516-938-9700

MEMBER RPI

Circle 10 on reader service card on page 42

News Briefs

● AMERICAN TELEPHONE & TELEGRAPH CO. has filed tariffs to be effective Nov. 1, which would permit the direct electrical connection of data terminal equipment through an inexpensive interface device, according to *Telecommunications Reports*. The new tariffs would permit acoustic or inductive connection of customer-owned equipment including private mobile radio telephone systems and authorized electrical connection of customer-owned terminal devices through a $2 a month protective device interface.

● BAY AREA RAPID TRANSIT DISTRICT of San Francisco has been turned down by the FCC for its request to use 160.860 mHz frequency in the railroad radio service for use in the motor carrier radio service. FCC said that frequencies in the 450-470 mHz band would appear suitable for the multiple base station system that BART has planned.

● BROTHERHOOD OF RAILROAD SIGNALMEN have completed their strike vote and, according to president **C. J. Chamberlain,** 97.5% of the members voted in favor of a strike. However, it is assumed that they would not go on strike if their present wage case was settled to their satisfaction. Chamberlain also announced that the National Mediation Board has assumed jurisdiction of the case.

● NEW YORK CITY TRANSIT AUTHORITY has received six Redec V solid-state supervisory systems to be used for remotely controlling rectifier substations in its power distribution network in Manhattan and Brooklyn. The control system was designed and built by the Relay-Instrument Division of Westinghouse Electric Corp.

● PENN CENTRAL has ordered 100 sets of coded cab signal equipment and 300 sets of intermittent inductive train stop equipment from the Signal & Communications Division of WABCO. The order, slightly under $1 million, is for equipment to be installed on locomotives to permit interchangeable operation on former lines of the Pennsylvania and the New York Central.

● SOUTHERN PACIFIC CO. has received an examiner's report and order of the Federal Railroad Administration, DOT, favoring its petition for discontinuance of automatic train stop systems between Oakland and Pittsburgh, Cal., 43 miles, and between Gold Run and Truckee, Cal., 54 miles.

● TELPAK rate schedules filed by Bell System companies, which went into effect Sept. 1, appeared to be holding in force. The FCC has denied a series of petitions by representatives of large users to hold the new Telpak rate schedules in abeyance. According to *Telecommunications Reports*, FCC said that it does not have statutory authority to take action to halt effectiveness of the rate changes or reschedule them over a 3-year period. FCC contends that under section 204 of the Communications Act, its tariff suspension power is limited to 3 months. FCC, in April, said that "users have been on notice since 1961 that Telpak rates presented substantial questions of lawfulness and that significant increases in these rates could result." FCC took its present stand not to suspend the rates any further, without a dissent, with five commissioners on hand for the meeting.

Railroad Personnel

● BALTIMORE & OHIO: **Herbert Sharp,** assistant signal supervisor at Chicago, has been appointed supervisor signals at St. George, Staten Island, N.Y.

● SOUTHERN: **Marion A. Otterbourg, Jr.,** district signal and electrical engineer at Greenville, S.C., was born March 15, 1918 in Ooltewah, Tenn. He joined Southern as a signal helper at Charlotte in 1939 and, two years later, was appointed assistant signalman. In 1943, he was promoted to signalman and, two years later, promoted to signal draftsman. In 1950, Mr. Otterbourg was made chief draftsman at Charlotte. A year later, he was appointed signal and electrical inspector at Washington, and became construction supervisor at Cincinnati in 1953. In 1955, he was appointed signal and electrical supervisor at Louisville, Ky., and in February of this year was promoted to district signal and electrical engineer at Greenville.

Rayford C. Pace, district signal and electrical engineer at Birmingham, Ala., was born in Bailey, Miss. on Dec. 17, 1926. He joined Southern as a signal helper in June of 1944 and was subsequently promoted to positions of signalman, leading signalman, and became S&E draftsman in 1950. In 1953, he was appointed signal foreman and two years later, was appointed assistant signal and electrical supervisor. Two years later, Mr. Pace was promoted to signal and electrical supervisor and in 1963, appointed circuit design engineer at Atlanta. He was appointed to his present position in February of this year.

Bernard G. Webb, assistant district signal and electrical engineer at Chattanooga, Tenn., was born June 4, 1907 in Pell City, Ala. He began his railway career in 1926 as an assistant signalman and assistant signal maintainer and, one year later, was promoted to signal maintainer. In 1942, he was appointed signal foreman and six years later, promoted to construction supervisor. In 1950 Mr. Webb was appointed assistant signal and electrical supervisor and two years later, was promoted to S&E supervisor. After holding the position of assistant engineer S&E, he was appointed chief signal and electrical inspector in 1957 and in 1964, was made general signal and electrical

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Jack E. Rupp
Gen Ry Signal

F. W. Smallenburg
Gen Ry Signal

Elliot M. Nesvig
Simplex Wire & C

Thomas J. Storc
Stromberg-Carlson

supervisor at Chattanooga. He was promoted to his present position of assistant district S&E engineer at Chattanooga in February 1968.

Robert M. Soule, Jr., process engineer-yards at Chattanooga, was born Oct. 22, 1928 at Athens, Ga. He holds a bachelor of science degree in physics from the University of Georgia. He entered Southern service as a junior engineer in 1959 and in 1964, was promoted to assistant supervisor-signal and electrical at Chattanooga. He was appointed to his present position in February of this year.

Supply Trade News

● ELECTRONIC ASSISTANCE CORP. will acquire Du Mont Mobile Communications Div. of LTV Ling Altec. The purchase agreement covers all Du Mont's products along with patents, engineering designs and tooling. EAC also has acquired Radiomarine Corp. and Hammarlund Mfg. Co.

● GENERAL RAILWAY SIGNAL CO.: **Jack E. Rupp,** manager of market planning, has been appointed head of the GRS Atlanta office. Mr. Rupp, a graduate of Carnegie Institute of Technology, was formerly in the marketing department of Union Switch & Signal Division of WABCO. He joined GRS in 1965 as manager, urban transit markets.

Frederick W. Smallenburg, sales engineer in the New York office has been promoted to sales operations specialist at the GRS main office in Rochester, N.Y. Mr. Smallenburg, a graduate of St. John Fisher College, in Rochester, joined GRS in 1960 as an engineer.

● GRAYBAR ELECTRIC CO., INC.: **F. D. Matsen** has been appointed assistant to vice president of operations at New York: **T. J. LeClair** appointed district manager at Minneapolis, Minn., succeeding **N. W. Zilch,** retired: **R. K. Jenson** appointed district sales manager there: **J. J. Moss** appointed district operating manager at New York and **A. A. Brzoski, Jr.** appointed district operating manager at Boston, Mr. Moss succeeds **J. C. Tresnauk,** retired; **G. B. Robinson** appointed manager at Duluth; **B. T. Gately** appointed manager at Manchester, N.H., succeeding **P. A. Dorn,** retired; and **R. C. Bothwell** appointed manager at Spokane, succeeding **H. O. Colburn,** retired.

● LONG SUPPLY CO: **Herbert W. Watkins,** formerly associated with Modern Industries Inc., is now a partner and will assist Mr. Long in representing several railway suppliers including Coleman Wire & Cable Co.

● LYNCH COMMUNICATIONS SYSTEMS: **Charles Chapin,** customer service representative, has been appointed application engineer at San Francisco. **Orlando J. Catelli,** former maintenance branch supervisor in the U.S. Army, has been named technical representative at San Francisco. **Paul J. Ralph,** supervisor radio relay section of the U.S. Air Force, has been named a technical representative.

● POWER CONVERSION PRODUCTS INC.: **Edward S. Weil, Jr.,** president, and **Chris F. Seyer,** sales manager, formerly of the Rectifier Products Div. of Fansteel Inc., have formed this new company which has purchased that division from Fansteel. The new corporation is located at 42 East Street, Crystal Lake, Ill. 60014. The new address is to be effective Jan. 1, 1969. Until then, contacts are to be made at the present North Chicago address of Fansteel.

● SIMPLEX WIRE & CABLE CO.: **Elliot M. Nesvig** has been appointed vice president and general manager of the power and control division. He is a graduate of the University of Wisconsin in electrical engineering and has a masters degree in business administration from the University of Chicago. Previously he was vice president, marketing and director of Okonite Co., Inc. and, prior to his recent appointment, he was vice president and general manager of the Thermoid Div., H. K. Porter Co., Inc.

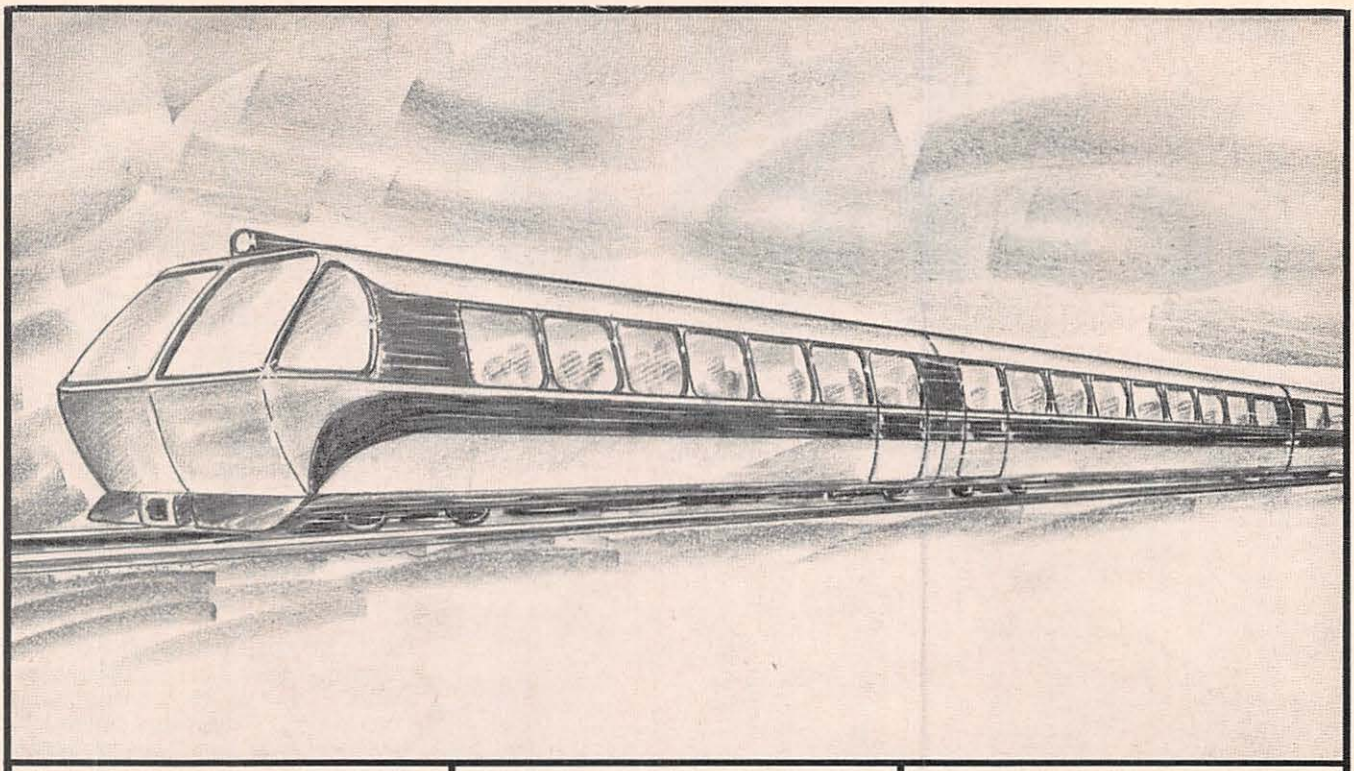
● STROMBERG-CARLSON CORP: **Thomas J. Storc** has been appointed manager of market and product planning. Previous position was held with Automatic Electric Co. in design and product planning and he joined S-C in 1965 as senior product planner and, a year later, was promoted to manager of product planning.

According to *Telecommunications Reports,* preliminary discussion regarding the possible merger of Superior Continental Corp. into Stromberg-Carlson has been held by officials of the parent companies.

● SYLVANIA ELECTRIC PRODUCTS INC: **Francis H. Stites,** senior engineering specialist, will receive the 1968 George R. Henderson Medal of The Franklin Institute, in honor of meritorious inventions or discoveries in the field of railway engineering. Mr. Stites is receiving this award for his invention of the KarTrak automatic car identification system which is now the standard ACI system of the AAR.

● TRANSCONTROL CORP: **M. T. Shanahan** has been appointed vice president and general manager.

Circle 11 on reader service card on page 42



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System 4000 would still be fast enough to control your traffic.

System 4000 eliminates previous restrictions on consolidation of railway traffic control. It brings in field data on a real-time basis, regardless of complexity of layouts, density of traffic, or miles of track.

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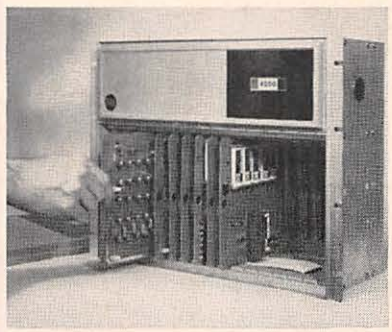
System 4000 uses the latest development in solid-state electronics—micro-logic integrated circuits. This new technique helps eliminate "noise," extends operating life, and minimizes maintenance. Designed on a module plan, System 4000 is readily expandable.



What else is new in transit? High frequency electronic track circuits and Wee-Z bonds—the electronic way to speed control, cab signaling, and jointless tracks.

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Circle 12 on reader service card on page 42

Railway
Signaling &
Communications

DT&I installs ACI at classification yard

Detroit, Toledo & Ironton has modernized its Detroit, Mich., classification yard. This flat switching facility, known as Flat Rock yard, was rebuilt under traffic into a semi-automatic retarder hump yard with controls, retarders and power switches furnished by Abex Corp. The yard is presently classifying about 1700 cars daily.

Four KarTrak automatic car identification scanners, a TCS-50 computer and three Teletype machines combine to monitor car movements through the yard. The Sylvania ACI scanners are installed to read car initials and numbers of inbound and outbound trains. Additionally, an ACI scanner at the hump crest identifies cars moving over the hump into the classification yard.

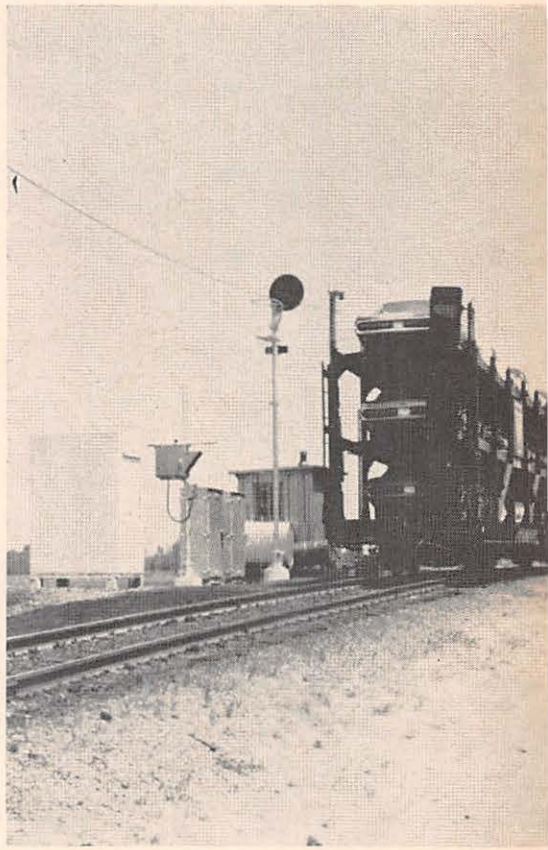
The ACI system with its computer provides DT&I management with a complete picture of its Flat Rock yard operation. Reports from the ACI system include inbound and outbound consists, inventory report on cars in the yard (prepared at 6 a.m. daily), departure report made every 8 hours showing cars departed since last 8 hours, and an exception report prepared daily showing cars delayed in the yard over 16 hours and under 48 hours.

"ACI gives us a good performance measurement on Flat Rock yard," says Charles L. Towle, DT&I president. It will pay its way in keeping track of auto-parts cars and auto-rack cars, which are all in high per-diem category, Towle reports. About 45% of the cars handled by DT&I are for Ford Motor Co. Although the road has experienced 80-90% accuracy in reporting on cars, the ACI system is catching that 10%. Many of these cars in assigned service are in a series with only the last two numbers differing. Here is where ACI can keep accuracy high, because experience has shown that people often transpose the last two digits of a car number.

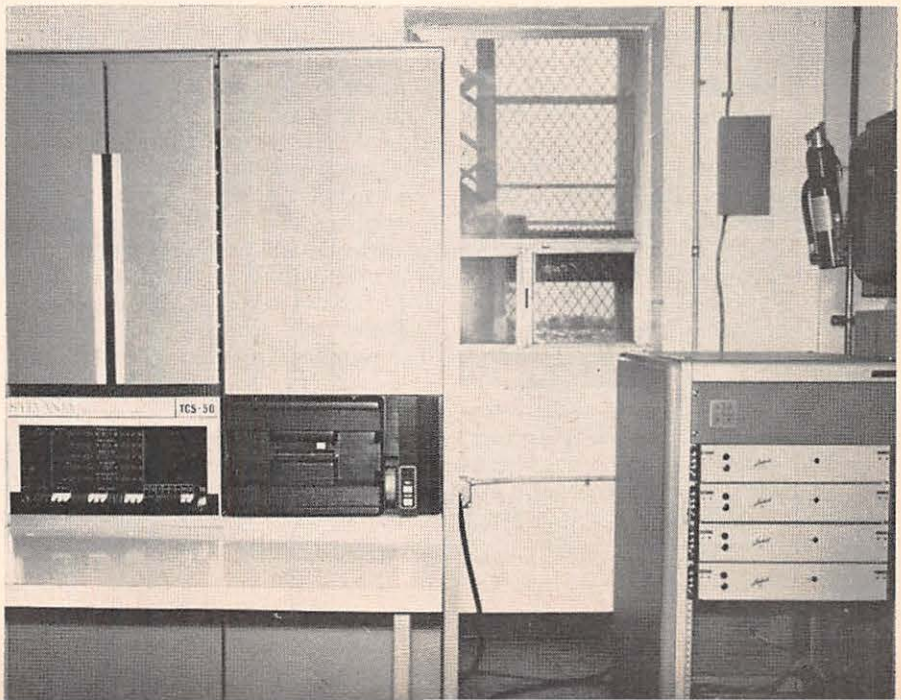
By the end of this year, DT&I will have labeled 6 to 8,000 freight cars, as well as all of its locomotives and cabooses. This means, says Robert O. Hughes, director of management services, that "we expect to get an 85% reading of cars off the Dearborn branch (to Ford's Rouge plant) and about a 60% reading on the mainline by the end of this year."

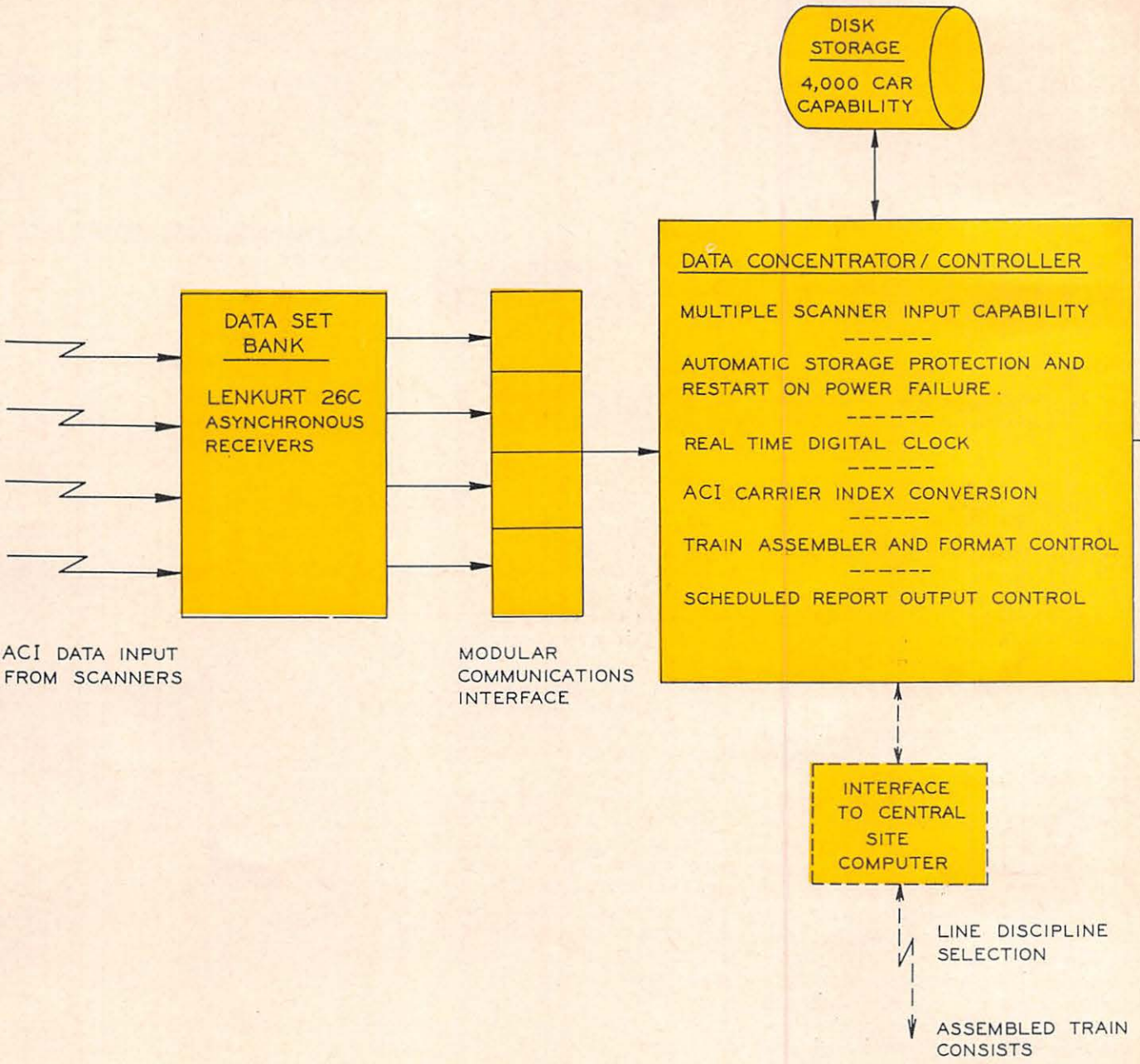
DT&I is labeling cars assigned to Ford Motor Co. service regardless of ownership. As a result, almost half of the cars handled at Flat Rock yard will soon be ACI labeled. Utilizing the wheel counters associated with the ACI scanners, gives DT&I an accurate car count of all trains, including unlabeled cars.

HUMP SCANNER SENDS ACI DATA . .



. . OVER 600 BAUD CIRCUIT TO CONCENTRATOR-COMPUTER





Flow diagram of the Sylvania TCS-50 on-line, real-time automatic car identification data control system installed on the Detroit,

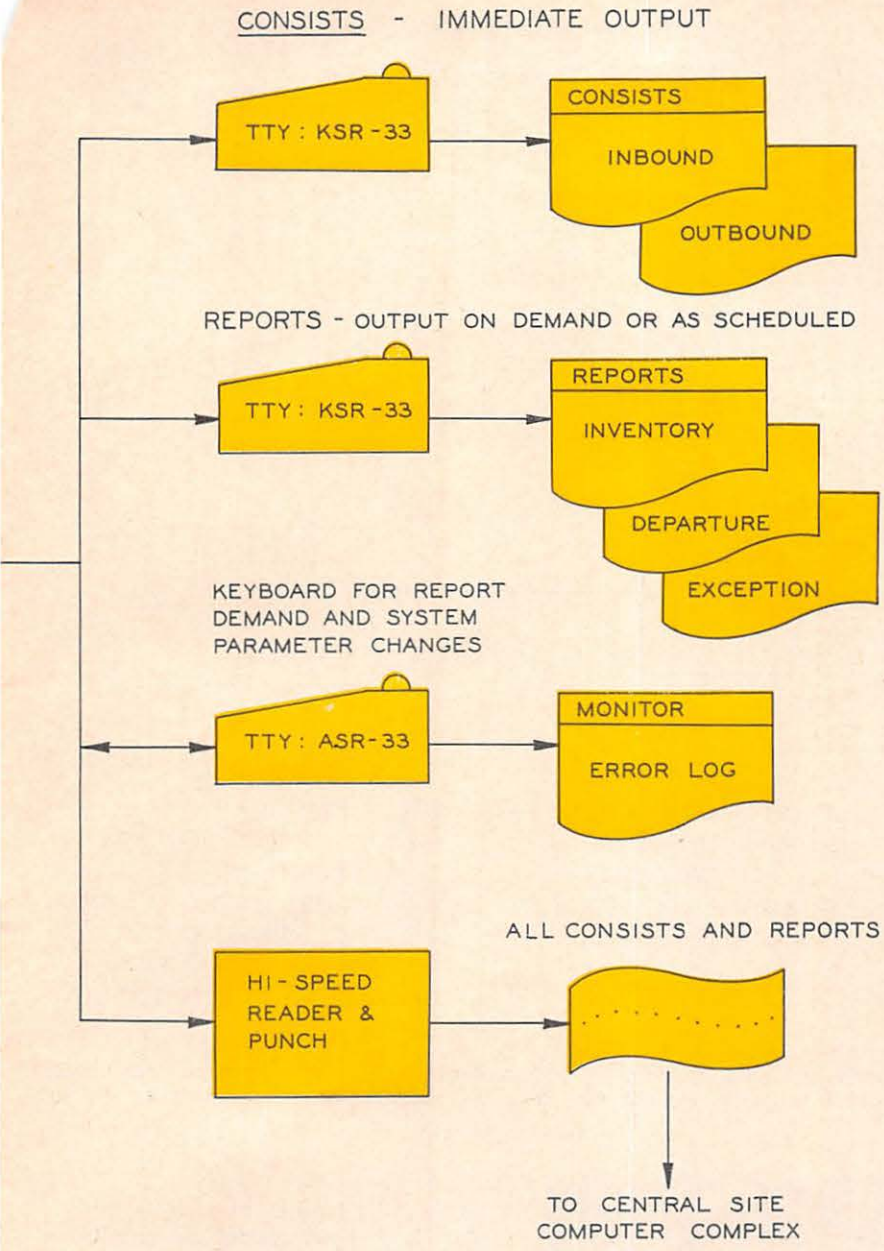
Data transmission from the scanners to the TCS-50 computer is in real-time using Lenkurt Electric Co. 26C data sets. The scanners at the north end of the yard at Van Horn road, feed data numerically over a voice channel on twisted pair wire direct to the computer. A preamble generator at the scanner location identifies the location to the computer. ACI control units and the data set are housed in an air-conditioned Armadillo Mfg. Co. fiberglass housing. Data transmission speed is 600 baud (trains moving about 20 mph), and data is sent on a character-by-character basis into the computer. Two wheel detectors are at each scanner location to provide accurate car counts. The ACI scanner at the hump crest is the same as the Van Horn road units, and transmits at 600 baud over a twisted pair wire.

Seven miles south of the yard, near Carleton, the fourth ACI scanner is located. This unit is turned on by directional circuits in the CTC system, the scanner being located in traffic control territory. After the caboose has passed, the ACI equipment automatically shuts itself off. Data transmission from this scanner is at 1800 baud using a leased Bell System 4A voice channel. Transmission speed permits train speeds to be up to 60 mph at this location.

The ACI equipment in this DT&I installation has the capability of reading six labels on TTX cars with stacked containers at either the 600 or 1800 baud transmission rates. Thus, DT&I has the ability to handle COFC or TOFC traffic without any changes being required in its ACI equipment.

The Sylvania TCS-50 computer contains two disk files of 32K character storage each, plus two core storage memories of 4K each. The 1800-car yard inventory is held on disk files. Also, the computer contains a dictionary with billing road codes and makes parity checks on the data transmitted to it. Reports are presently printed out on Teletype machines located adjacent to the computer in the retarder tower. One machine will be retained at this location for input/output purposes, while the other two Teletypes will be moved to the yard office.

The TCS-50 now punches out 8-



Reports tell the story

Daily and real-time (as it happens) reports provide DT&I management with accurate, current information concerning performance of the Flat Rock classification yard. The five reports are prepared by the TCS-50 ACI computer. They include:

Inbound Consist—Shows train number, time, day, origin (location), ACI scanner number, and direction. Listed is the consist showing locomotive initial and numbers, and car initials and numbers (/—indicates unlabeled cars), caboose initial and numbers, and the total number of cars.

Outbound Consist—Shows train number, time, day, destination (on DT&I), ACI number and direction. In addition to locomotives, cars and cabooses by initials and numbers, time and date of first and last humping of each car is given, the number of times humped, and the arrival time and date of the car including the origin point on DT&I. At the end of the report is the total number of cars.

Departure Report—Published daily lists all cars departed from Flat Rock yard since the day before. The cars are listed in numerical order. For each car is shown the destination on the DT&I, departure time, origin point and the hours and days held at Flat Rock. Also reported is the total number of cars destined for major points on the DT&I.

Exception Report—Published daily lists cars delayed over 16 hours and under 48 hours in order of longest delay to least delay. This report may be reduced to cover only cars held between 12 and 32 hours. Car initial and number is included with hours to first hump, hours held, time and date of arrival with point of origin.

Inventory Report—Published daily listing cars in numerical order showing time and date of first hump and last hump, number of times humped, arrival time and date and origin location. Also included is a total number of cars.

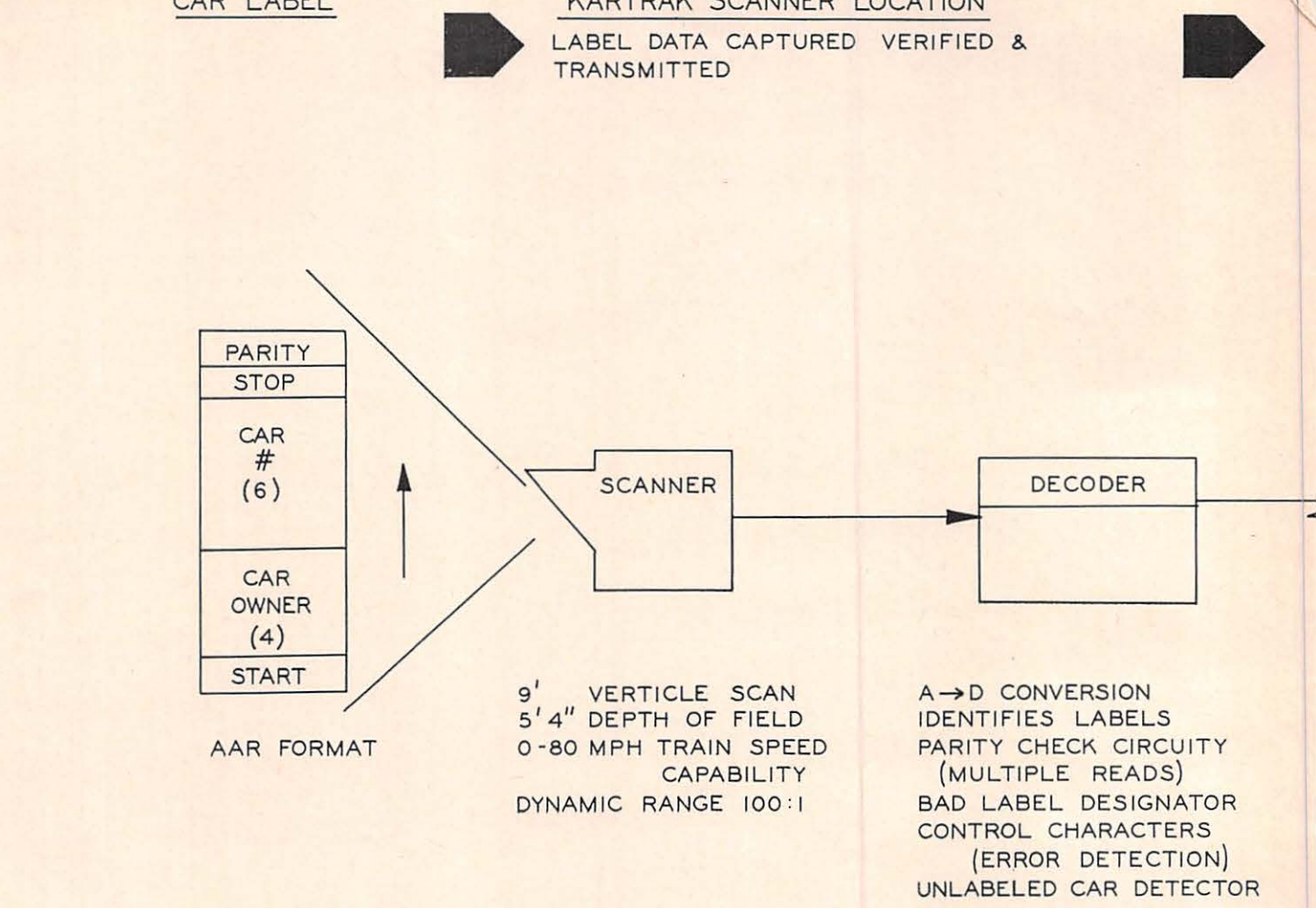
Toledo & Ironton at Flat Rock yard, near Detroit, Mich.

level paper tape in IBM 1050 code. When DT&I has its IBM 360/40 computer fully operational, it will poll the ACI computer.

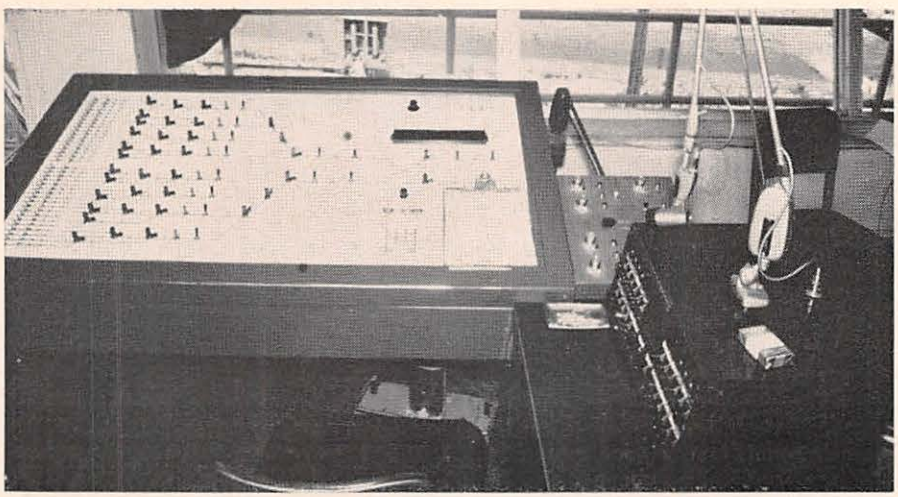
The ACI system is leased from Sylvania including equipment maintenance. The equipment rental for the four scanners, the computer, the 26C data sets, and Teletype units runs to $3500 per month. The monthly maintenance contract is $1,000.

To handle its classifying more efficiently (some cars are scheduled through the yard in only 3 hours or less), DT&I rebuilt its flat switching facility into a semi-automatic retarder hump yard. Cars are pushed up a 0.87% grade to a level section at the top of the hump, after which they roll down a 3.5% grade through a section of tangent track to the 78-ft master retarder on a 1.9% grade. Next, cars roll over a 0.4% grade to two 78-ft intermediate retarders spotted on a 1.2% grade. From the intermediate retarders to the group retarders (39 ft long), the grade is 0.12%. Through these group retarders the grade is 0.80% and the class tracks beyond are on successive grades of 0.45% and 0.12%. At the ends of each of the 36 class tracks is a Racor inert retarder to prevent cars from fouling the pull-back leads.

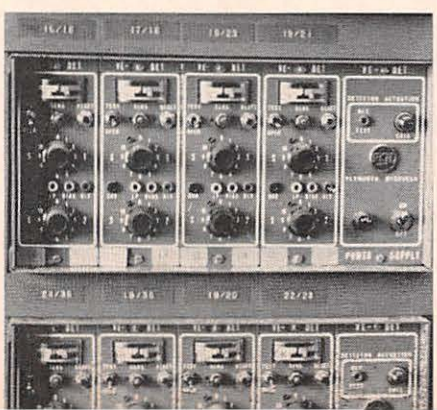
Abex Corp. type 600 speed control system is used. A notched rail, (one length in approach to each retarder) and one rail through the retarder is used to determine speeds of the rolling cars. Leaving speeds from the retarders are determined by electronic modules in the speed control equipment. However, the car retarder operator can raise or lower these speeds by operating High, Medium or Low speed levers on his control console. For example, on July 10, the leaving speeds for the master retarder were set as follows: high- 12.5 mph, medium- 12.3 mph, low- 10.2 mph. For the intermediate retarders, leaving speeds were: high- 10 mph, medium and low at 8.5 mph. For one of the group retarders, the high speed was set at 7.0 mph, medium at 6.0 mph and low at 4.0 mph. These speeds were calculated from the yard design taking into account curvature, grade and general rollability of cars. The speed modules are changed to take into account the variation in rollability due to winter



Functional block diagram of phase 1 of DT&I ACI system. In phase 2, assembled train messages will be sent, upon request, directly responsibilities; thereby making it possible for the TCS 50 to service a great many more ACI scanners on a demand basis.



Car retarder operator has control console (left) plus communications console (right).



RCA presence detectors prevent operation of class yard switches when unsafe.

and summer weather.

Single-rail retarders are used in this facility. The speed control system sets the retarders prior to entrance of a car or cut. After determining the speed of the cut from the notched rail measurement, the retarder can be opened if the cars are rolling too slow.

The hydraulically operated power switches in the class yard are lined automatically by the car retarder operator pushing a button or buttons for the number of the class track to which the car or cut is to be routed. To assure that switches are not thrown under a car Radio Corp. of America and Link presence detectors were installed.

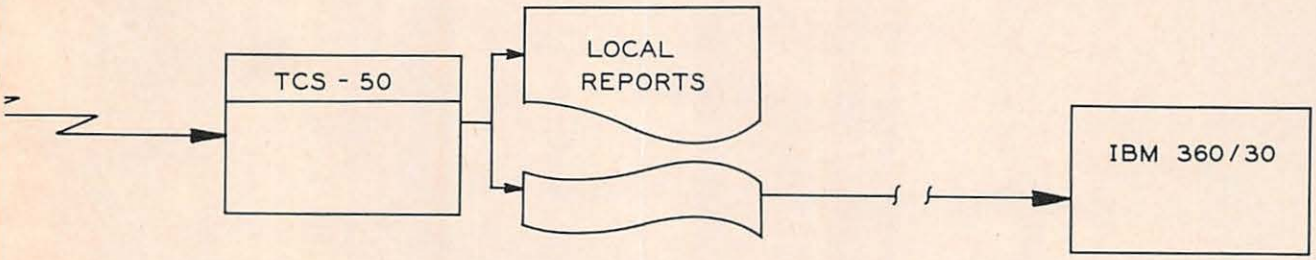
Wayside colorlight hump signals are used for direction of the humping operation. Additionally, two-way radio provides communication between the hump conductor, yardmaster, the hump engineman and the car retarder operator. Also, a hump talk-back speaker system provides communication from the retarder operator and the pin puller and hump conductor. R. W. Neill Co. provided a complete talk-back and paging speaker system for the yard.

SYLVANIA TRANSPORTATION CONTROL SYSTEM-50

LABEL DATA RECEIVED VERIFIED AND ASSEMBLED FOR TRAIN CONSIST REPORTING AND FILE MAINTENANCE.

CENTRAL SITE

INTEGRATES DATA FROM ACI DATA COLLECTION SUB-SYSTEM INTO TOTAL MANAGEMENT INFORMATION AND CONTROL SYSTEM.



CHECKS PARITY BY CHARACTER AND LABEL
CONVERTS AAR REVENUE BILLING CODE TO REPORTING MARK
ADDS TIME OF DAY AND DAY OF YEAR
REFORMAT PIGGYBACK DATA
PERFORMS FILE MAINTENANCE
REPORTS PRODUCED AUTOMATICALLY / OR UPON REQUEST
ALL TRAIN MOVEMENT DATA OUTPUTED ON PUNCHED
PAPER TAPE FOR ENTRY INTO CENTRAL SITE
INFORMATION AND CONTROL SYSTEM.

to the central computer facility. At that time the central computer site will also take over the file maintenance and output reporting

Eight Esterline-Angus recorders are used to monitor the automatic switching pushbuttons and to provide a record of just what happens. Events recorded include track to which automatic switching request is made, normal or reverse position of each class track switch, when presence detectors are operative, and when retarder controls are on automatic or manual mode. The monitoring system tells what the car retarder operator called for and where the car actually went.

DT&I has a lead signal maintainer on duty five days, 7:30 a.m. to 4 p.m., Monday through Friday. Assisting him is a signal maintainer during the same day tricks. A second trick maintainer works Monday through Wednesday and this man covers on first trick Saturday and Sunday. Heaviest traffic through the yard is Wednesday to Saturday.

When the class tracks are being pulled, the car retarder operator "blue flags" those tracks. A blue flagging system is included in the automatic switching control system. When the car retarder operator is informed that car men desire to work on a particular track, the CRO operates a small blue flag lever for that track on his control console track diagram. This locks the switch out for that track so that he cannot route a car manually or automatically to the track so blue flagged. A blue indication lamp is illuminated on his panel diagram to remind him that the track is being pulled. This blue flagging system is also used to protect car men when they are working cars on class yard tracks.

The Flat Rock retarder yard has now been in full operation for about 9 months, and according to DT&I officials, it is doing an excellent job in handling the traffic—some 1600 to 1800 cars are humped daily. Car time in the yard has been materially reduced. For example, any car into the yard at 5 p.m. will be classified and out on a train, and off-line by midnight if the off-going junction is within 75 miles of Flat Rock. It is not unusual for cars to arrive in the yard, be classified and moving in outbound trains or transfer cuts within two hours.

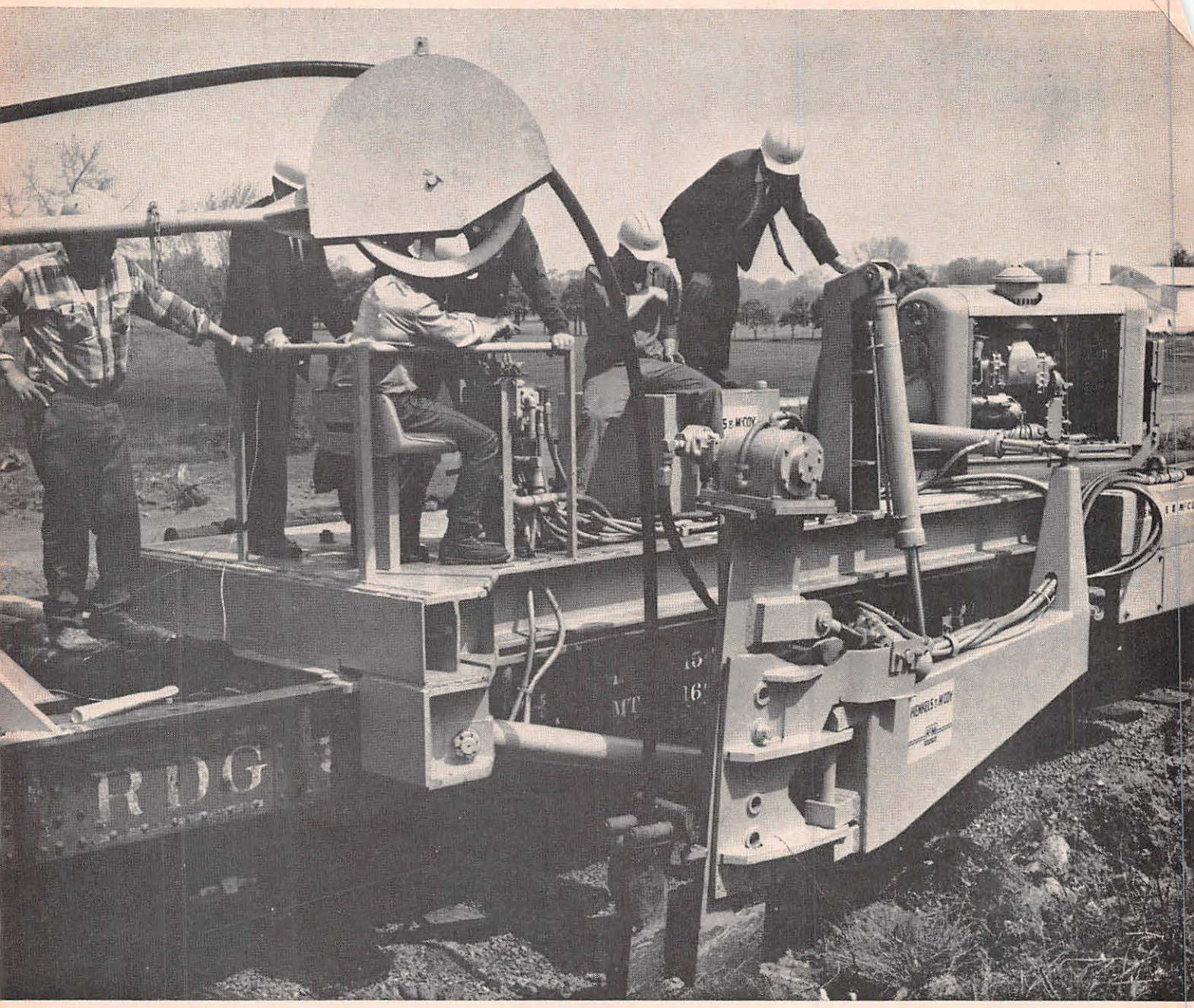
ACI and the semiautomatic retarder yard are paying their way on DT&I.

Building for the future

The present ACI system was designed and installed with the goal of being compatible with future management needs of the railroad. For example, during the first quarter of 1969, DT&I expects to have its IBM 360/40 to be coming on line. This central computer at the road's Dearborn headquarters office will then poll the ACI computer at Flat Rock yard. Some of the housekeeping chores of the ACI computer will be taken over by the 360/40 facility.

When such a takeover is accomplished, the ACI computer will probably handle additional ACI scanners. It is estimated to be capable of handling up to 16 such scanners. Additional scanners may be placed at entrances to Ford's Rouge plant and at nearby interchange points.

Management Services director Hughes says that the present ACI system is providing him with live data which helps him in developing a program when the 360/40 is operational.



Cable is fed from reel through the pulley into the cable chute which directs it into the ground directly behind the plow.

Underground cable: Plow it in

A railroad cable plow has been successfully tested in a pilot installation in burying underground cable on the Stony Creek branch of the Reading. Developed by Henkels & McCoy, Inc., the railroad plow is an adaptation of a similar unit that has been used for many years for plowing in power and communications cables alongside roads and cross country.

In the Reading project, a 52-pair signal and communications cable (slightly less than 3" in diameter) was successfully plowed in parallel to the track but outside the tie line.

In railroad plowing, a locomotive, a flat car for the plow and a gondola for the cable reels are used. The plow is sidemounted on the flat car.

The vibratory blade of the plow exerts 22,000 ft lb of force. The blade, which is inserted into the ground to a depth of as much as 44", creates a furrow into which the cable is laid. The cable is fed into the furrow from a roller-bearing equipped cable chute which is attached to the back of the plow. The vibratory power of the plow creates fines in which to bed and surround the cable. Thus, little or no backfilling is required.

One requirement is that the locomotive be equipped with full rheostat control, because it must be operated at speeds from 1 mph to 3.5 mph, when plowing.

Depending upon the flexibility of the cable, sizes up to about 3¾" in diameter can be accommodated. The cable

can be laid at the edge of the tie line or out to 5-6 ft from the edge of the ties.

The plowing unit, which is hydraulically powered by its own diesel engine, offers flexible articulation through five piston-operated cylinders. One cylinder moves the plow horizontally to permit the operator to plow from the edge of the tie to 5-6 ft out. Another cylinder operates vertically to plunge the plow to a depth of 44". The plow can be tilted 3 ft in either direction through the use of a tilt cylinder. Its blade can be turned at any angle up to 40 deg. To prevent damage to both plow and cable, the unit is equipped with a blade release cylinder that kicks the blade out of the ground when it comes up against an obstacle that it cannot move out of the way or move around.

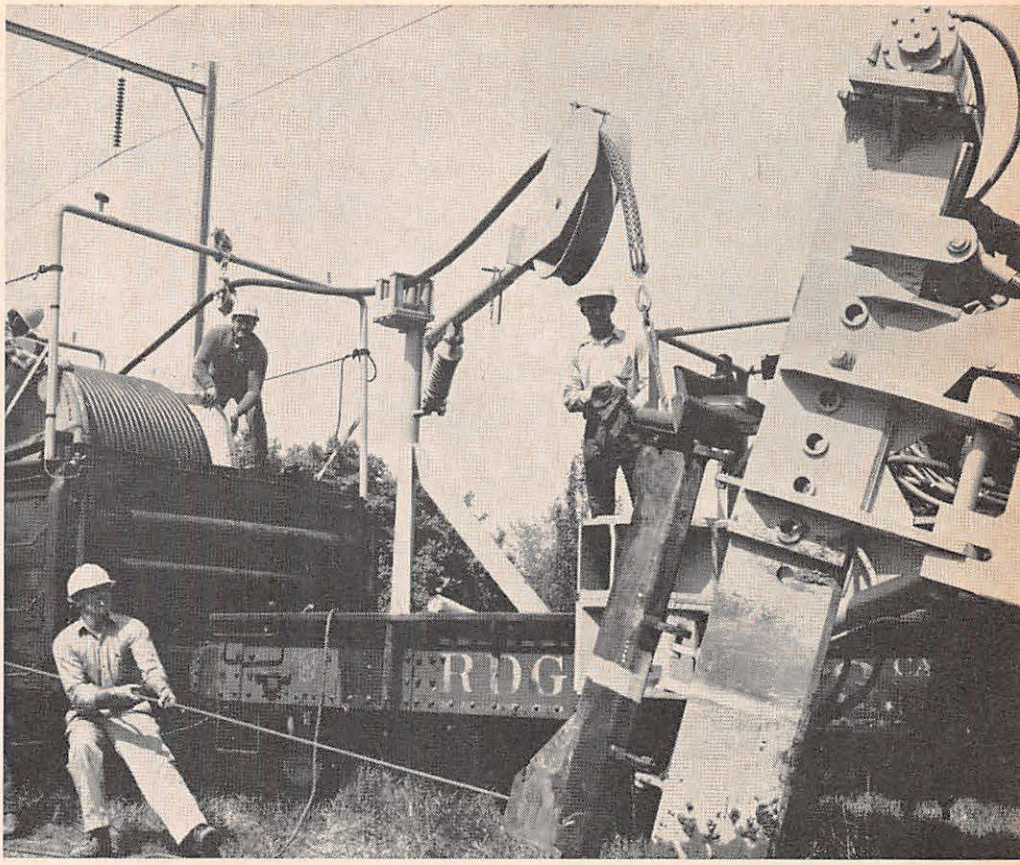
Normally, the plow will simply push aside most obstacles such as debris or small rocks or boulders buried in its path. If the rock is fairly large, the blade will move around it to lay the cable to the side.

Frequently cable can be plowed on the first pass, but in severe rock areas it may be necessary for a prerip pass to loosen the earth before plowing in the cable.

A 3-station, battery-operated telephone system keeps the engineer of the locomotive, the plow operator and the cable reel tender in constant communications. Headsets with chest-carried microphones are used to provide hands-free operation by the users.

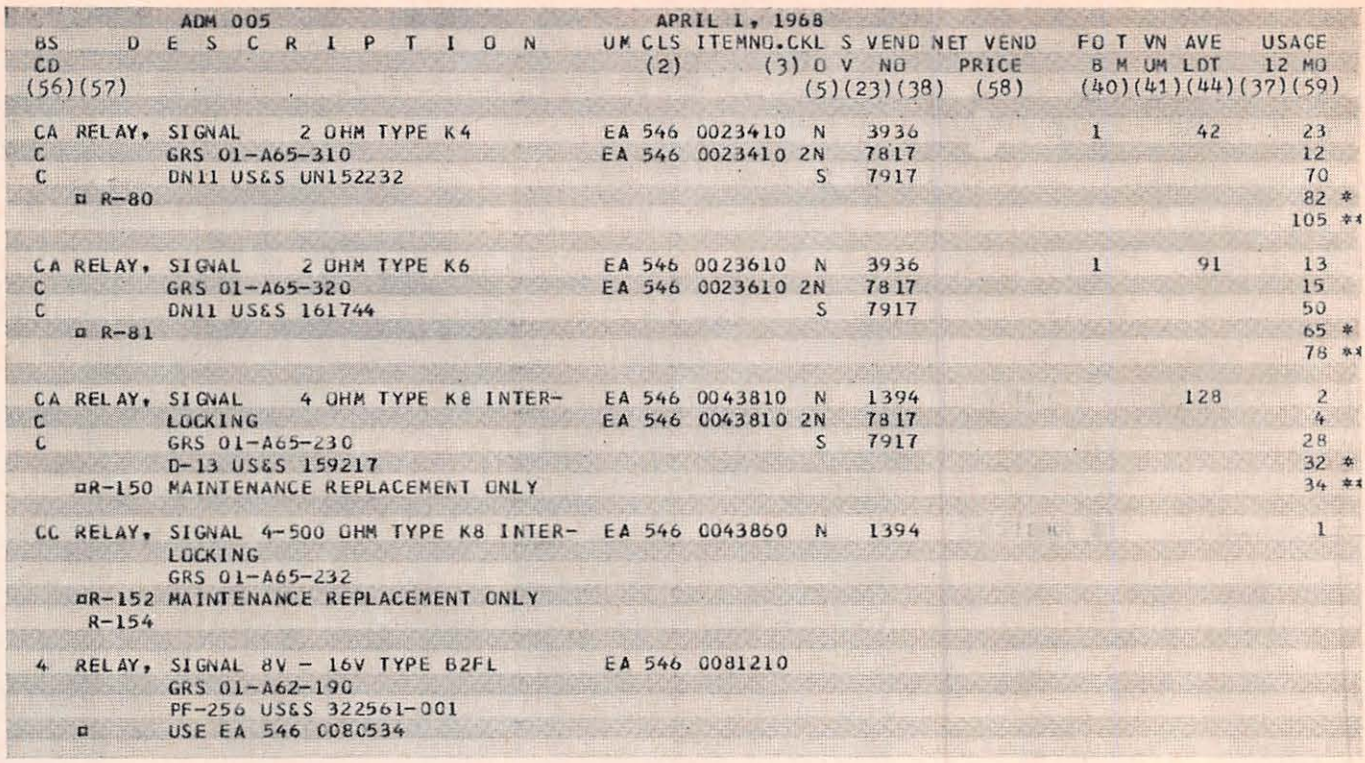
Because use of the track is required in this work-train type of operation, some railroads with commuter operations have expressed interest in ability to plow at night. A Henkels & McCoy spokesman said it is entirely feasible for them to provide floodlights at each end of the flat car and a diesel engine generator to provide power for the lights. Although not now equipped for night work, such lighting could be provided.

The present side-mounted plow is on one side of the car only. However, work is now underway for developing a dual-plow car with plows on both sides of a flat car. Although they would not be operated simultaneously, it would be possible to plow on either side of the track without reversing the train. One railroad has expressed interest in such an operation, because it would like to plow cable in between tracks on a multiple track line.



Special rope attachment is used for threading underground cable into chute.

Train for cable plowing consists of locomotive, plow car, reel car and caboose.



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C         GRS 01-A65-310                EA 546 0023410 2N   7817                          12
C         DN11 US&S UN152232                           S   7917                          70
   ¤ R-80                                                                                82 *
                                                                                        105 **

CA RELAY, SIGNAL     2 OHM TYPE K6      EA 546 0023610  N   3936          1       91      13
C         GRS 01-A65-320                EA 546 0023610 2N   7817                          15
C         DN11 US&S 161744                             S   7917                          50
   ¤ R-81                                                                                65 *
                                                                                         78 **

CA RELAY, SIGNAL     4 OHM TYPE K8 INTER- EA 546 0043810  N   1394                  128     2
C         LOCKING                       EA 546 0043810 2N   7817                          4
C         GRS 01-A65-230                               S   7917                          28
          D-13 US&S 159217                                                               32 *
   ¤R-150 MAINTENANCE REPLACEMENT ONLY                                                   34 **

CC RELAY, SIGNAL 4-500 OHM TYPE K8 INTER- EA 546 0043860  N   1394                          1
          LOCKING
          GRS 01-A65-232
   ¤R-152 MAINTENANCE REPLACEMENT ONLY
    R-154

4  RELAY, SIGNAL 8V - 16V TYPE B2FL      EA 546 0081210
          GRS 01-A62-190
          PF-256 US&S 322561-001
   ¤      USE EA 546 0080534
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Computer print out shows information pertaining to signal relays, which are stocked at North Little Rock, Ark., and Sedalia, Mo. Numbers in parentheses are as follows: (56)—Buyer code indicates who buys the item. (57)—System designator indicates by an A, B or C the system dollar volume of usage in the past 12 months on the length of time for which no usage has been recorded. (2)—Stock Control Masters. The caption shows the type of record printed out. Beneath this caption are shown the unit of measure, class and stock control number. (3)—Kind Code, kind 2 means secondhand. (5)—Location, S = Sedalia, N = North Little Rock. (23)—System Vendor, an asterisk in this column indicates that one vendor supplies all points stocking the item. (38)—Vendor Number indicates the vendor from which the relay is purchased for this location. If secondhand, the number indicates MoPac warehouse from which it is furnished, 7917 = North Little Rock. (58)—Net Vend Price is net purchase price of the item, which is not shown here because of its confidential nature. (40)—FOB code indicating the F.O.B. point. For a new relay, a 1 in this column indicates F.O.B. shipping point. (41)—Terms code indicates terms such as 2% 10 days would appear if applicable. (44)—Vendor Unit of Measure if different from that used by MoPac. (37)—Lead Time, average lead time from past history in days. (59)—Usage, regular and program (program followed by usage for the past year). Last figure, followed by ** is total usage.

S&C in material management

The requirements of the Missouri Pacific's signal and communications department are included in the material management system. Purchases and Materials Department on the MoPac is responsible for procurement; also management of all unapplied material and supplies.

Equipment and supplies for S&C on the MP–TP–C&EI are now being handled out of the material distribution center at North Little Rock, Ark.

With the system, a computer chooses suppliers from whom purchases will be made, and keeps track of all of the details in connection with on line supplies.

The following are the five basic objectives sought in the computer controlled operation, which includes the S&C system:

- Control M&S by an automatic reordering system.
- Establish a system average price for each stock item.
- Provide accounting distribution of issues and receipts on a semi-automatic basis.
- Select vendors and prepare purchase orders automatically.
- Provide management information by periodic reports, exception reports, and through provision for inquiry.

Stock signal and communications materials are furnished directly from the material distribution center at Little Rock on a regular well defined shipping schedule.

There are some exceptions, however, and provisions have been built into the system to provide for emergencies and the ordering of material for a completely new system of installation such as CTC or a retarder yard.

Where provisions are made for the purchase of emergency supplies at specific locations, blanket orders have been set up. In addition, there are provisions for "special expense drafts" that will allow local purchases of non-stock materials up to $200. It was pointed out that when the purchased material is a stock item at the material distribution center, there must be a very good reason why it was purchased in this manner; and it should be due to a true emergency.

"When ordering material for the S&C or any other department we all work together for the benefit of the MP as equal partners in the deal. Using a CTC system as an example, requisitions and specifications for the new project are submitted by S&C. Bids will be obtained from those companies that can handle the job. The proposals and specifications received will be analyzed by S&C to insure that these bids will meet the requirements. S&C also

submits its recommendation as to which system to purchase," explained Donald H. Rettinger, manager of purchases.

Rettinger explained that if the supplier of the recommended system was also the low bidder there are no problems. If, however, it is not, purchasing will get together with S&C to determine the reasons for the recommendation and establish a pattern or basis for negotiations for an acceptable system. to both S&C and P&MD.

"We consider that we and the various using departments are working toward the same objectives and are cooperatively seeking the best possible buy for MoPac", Rettinger said.

In effect, there are two well defined patterns available to S&C. One is to obtain material from stock and the other is to obtain other than stock material.

Much has been done to simplify and expedite the distribution of stock items to signal forces in the field.

While a number of things contribute, one of the determining factors is MP's effective method of handling system-wide LCL freight.

Without this, it would be almost impossible to maintain the shipping schedule on which distribution is based. Once a requisition is approved, stock material can be delivered to any point on the railroad within a week and in many cases it can be done in three days.

Material is requisitioned by S&C men in much the same manner it has been done in the past and the requisition approval chain has changed very little. The big advantage has been in the handling.

The signal "stock list" previously published by the signal department listed almost everything that would be needed including paint, wire, relays, etc. The new "material stock catalog" contains much of the same material but it has been simplified and designed to be more usable. "In effect it is more like a Sears Roebuck catalog", making the ordering of supplies by number a simple task, said R. E. Rathert, manager of materials.

Ordering by number has taken the specialist out of the stock room. In the warehouse, the requisition is filled by the item number only.

"Previously we had 'experts' who filled requisitions", Rathert explained "They would sometimes substitute materials. In addition, these 'experts' would be confined to work in certain areas. Now, we have flexibility and we can use any employee in any area. This provides flexibility and efficiency. If they are given a number they don't have a choice and the item requested is the one that will be shipped," Rathert said.

Some things have been simplified for the S&C men in the field. At one time each item in an installation had to be ordered separately. Now, they are purchased as a package and stocked as a unit. A crossing flasher is a typical example and consists of a crossing flasher, with lamp, pole, step, extra length mast, junction boxes, brackets, sign brackets, light units, without crossbuck signs. It will be noted that the material stock catalog also lists those items which are not furnished in the package.

A high degree of standardization is developing under the new system. At one time the MP had one set of established standards, T&P had another and while their equipment was similar there were some that were "oddball" T&P and some "odd-ball" MP. Items previously listed that have been standardized can no longer be ordered, but, if a request comes in for that item the materials department will provide the standard item. The old item is left in the catalog as a reference and if someone in the field should need this standardized item there is a notation referring him to the proper one to order.

With the C&EI now coming into the picture it will be necessary to standardize its equipment with that of the MP-TP to include it in the overall material management system.

Ironically, the list of S&C stock items is greater today than before the computerized inventory control system was inaugurated. This is because most signal items were formerly handled on a specialized, hand-to-mouth basis and the stock list was limited. Today, the computer has pinpointed a longer list of items used repetitively, justifying their inclusion in stock.

Under computer control of inventory the new system works like this:

For example, a signalman (at any point on the railroad) needs material. He prepares his list from the catalog and forwards it through the requisition approval chain. He has been advised when his requisitions must be sent in to fit in with the shipping schedule for his area. The requisition must be in three days before the shipping schedule.

The approved requisition is received in Little Rock and the request is filled and loaded for shipment to the user. At that time an IBM punch card is prepared showing the items shipped, who received them and the account it is charged to. This data is sent to the computer in St. Louis via IBM 1050 over voice grade communication lines.

If the car is loaded by afternoon all information regarding the shipment is in St. Louis by 9 p.m. and the perpetual inventory will be updated by midnight. The material has been shipped to the signalman and his needs are now satisfied.

Rathert admitted that they have not always been infallible on this point and once burned signalmen in the field became doubly cautious. "It is necessary to make believers out of the men in the field and the only way we can do this is to perform. If that man can make his requisition and in a week receive his supplies he will, after a time, reduce his on-hand inventory. He can see that he doesn't need it. If, however, he is depending on that service and it fails, that memory will remain in the field for a long time," Rettinger said.

"As an example, a little more than a year ago signal lamps were in short supply, we couldn't buy them fast enough," Rettinger said. "Everyone was out and panic buttons were ringing all over. Right now we are feeling the effects of that. The signalmen won't let that happen to them again. We have recovered, but that memory still remains."

When the punched cards recording the transaction are received in St. Louis, they are sent to the 2314 (disc storage file); the IBM 360/40 is the card to tape medium.

Within the computer, the quantity on hand is reduced, date of last issue and usage in current month is updated and the average price is applied and dollar balance adjusted. The value of the transaction is charged to the proper account.

Information Available

Information concerning any stock item on the system is immediately available upon inquiry from the computer:

- System quantity paid for
- System average price
- System dollars paid for
- Last draft number applicable to the item
- Control warehouse
- Contract expiration date
- System vendor number
- Item unit weight
- Stocking locations
- Date of last issue each location
- Quantity on hand each location
- That portion of quantity on hand earmarked for specific uses
- Quantity on order regular each location
- Quantity on order program each location
- Reorder point each location
- Reorder quantity each location
- Usage normal current month each location
- All other usages current month each location
- Quantity purchased year to date each location
- Lead time
- Vendor number
- Purchase price, terms, F.O.B.
- Account chargeable

The computer will initiate an inquiry to determine whether it is time to reorder. This is based on a predetermined re-order point and if the balance on hand and on order is reduced below that point the question is asked—"who do we buy from?". This information was also fed into the computer at an earlier date by the purchasing department. After determining all of the necessary information the computer will type out the order addressed to the proper supplier to be checked and signed by the purchasing agent.

That one requisition for material started this entire chain of events. The material has been delivered, proper charges have been made, and steps have been taken to insure that there is an adequate supply of material on hand to take care of future needs.

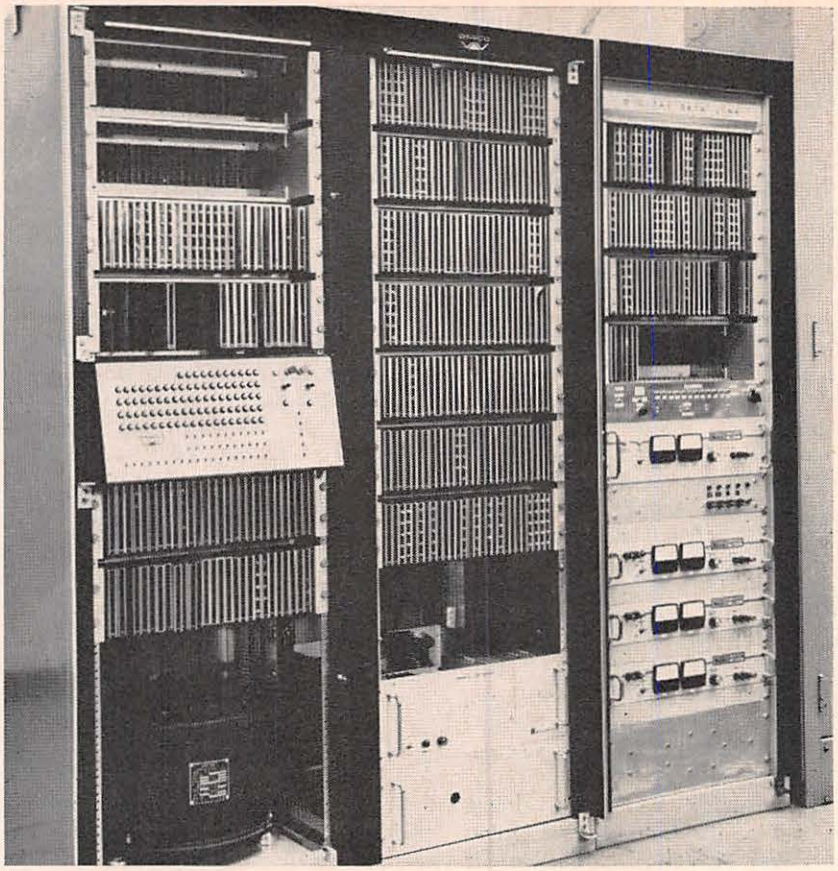
One item has been programmed into the computer to prevent the purchase of new material as long as there is any on hand to be repaired in either of the two signal repair shops at Sedalia, Mo. and Marshall, Tex. If repairable material is available the computer will then initiate a shop order for repaired material.

At one time, Rettinger said, the demand on the shop would exceed the capacity and the railroad would be tied up waiting for the equipment. This has now been adjusted and if repaired items cannot be furnished in a reasonable time the necessary number of new items will be purchased to take care of the demand.

When a requisition is received it is filled completely. There is never any question about the quantity ordered. The MP recognizes that there is sometimes a tendency to order just a little more than is needed. There are three material control supervisors on the MP system who will visit all points on the line at frequent intervals in an effort to control the stock-piling of material in the field. Rathert said that this has been very effective.

"The thing we are most anxious to do from a purchasing standpoint is to maintain a competitive atmosphere." Rettinger said. "We must maintain this atmosphere. A company of our size cannot become wholly dependent upon one supplier in a certain field. There are reasons, and sometimes good ones, for going to all one type signal equipment, but we must weigh the benefits of standardization, the benefits that can be maintained and obtained by keeping a competitive atmosphere.

"We would appreciate it if you would call us the materials department", Rathert said, "we do not have a store department. We are here to distribute material."



Computers controlling CTC and yards must be protected against transients.

How to apply surge protection devices

By Fred A. Kahl
Sales Manager
Joslyn Electronic Systems

Within the railroad property many new transistorized devices are making their appearance, and the point at which impairment of performance takes place is much lower than with electromechanical relays and other devices that are used to provide the control and communication functions necessary to modern railroading. However, the older systems are in need of upgraded over-voltage transient protection also.

The underlying driving force which is acting to provide better operation of the railroads is basically an economic one, coupled together with increased safety of all personnel. Before we get into those two topics so closely allied to the over-voltage transient problem, let's look at the environment that makes it mandatory to obtain better protection devices.

Over-voltage transients, or transients as we will refer to them, are voltages appearing on a pair of wires that are used to provide signal, communications, and power to many different devices used by the railroads (and many other industries who have similar problems).

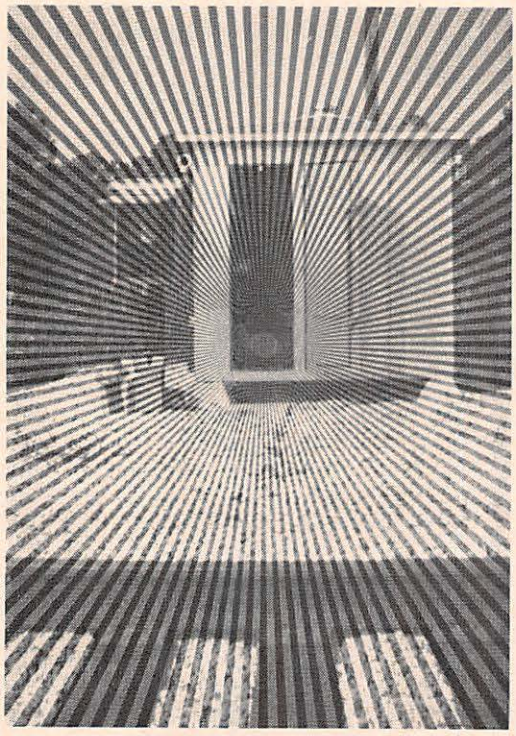
Before we design and/or build any protective devices, let us examine the nature of these transients. Figure 1 shows a pair of wires that are carried on poles and crossarms across country from one termination to another. These two wires can pick up two kinds of transients. These are referred to as "metallic" or "longitudinal".

When a pair of wires is used to transmit information (signal and/or communications, or power), the current flow in the two wires is "metallic", and a difference of potential exists between them. Therefore, a metallic transient is one that has current flow similar to the signal and it may be of any polarity.

If, on the other hand, both wires assume the same potential and polarity, when measured to "earth", the transient is said to be "longitudinal". No longitudinal current will flow unless there is

(Please turn to page 26)

Ten years from now the electronics in this bungalow will still be working despite repeated strikes by transients



. . . because of Joslyn protectors.

It already has a three-year old record for transient damage-free operation since installation of Joslyn's surge protection equipment. And that's just the beginning of a transient damage-free system along the entire line for the Florida East Coast Railway. They're using two Joslyn Series 1600 Communication Protectors and one Joslyn Series 1000 DC Protector in each bungalow.

SERIES 1603-01 SPECS: max. signal peak volts — 0.775; discharge rating — 40 ka 10 x 20 μs; max. output volts — <100 at 1 μs; transient into protector — 10 kv peak with 10 ka peak 10 x 20 μs; frequency range — dc to 1 mhz. Just a few typical performance figures that make this series unbeatable.

SERIES 1001-01: nominal input — 28 v; load current — up to 15 a; clamp level — 45 v to 50 v; max. output — <90 v; max. transient into protector — 2 kv peak with 5 ka peak 10 x 20 μs. Typical specs that meant added protection for the Florida East Coast Railway.

And the entire cost of the protectors was repaid within six months of installation with the savings made possible from the reduction in maintenance, equipment replacement, and disrupted schedules!

But don't take the Florida East Coast Railway's testimony as the last word. Or the fact that Joslyn claims their equipment is built to provide positive protection for virtually the life of the products they protect. Ask the airlines. They've been flying with Joslyn transient protection for years. And they can't afford a failure . . . whether it be caused by lightning or what have you . . . up there.

Write or call today to learn how a Joslyn surge protection network can eliminate transients on your railroad. Joslyn Electronic Systems, Santa Barbara Research Park, P.O. Box 817, Goleta, Calif. 93017. Tel. (805) 968-3551.

Complete specs available in VSMF, Visual Search Microfilm File.

JOSLYN
ELECTRONIC SYSTEMS

Circle 14 on reader service card on page 42

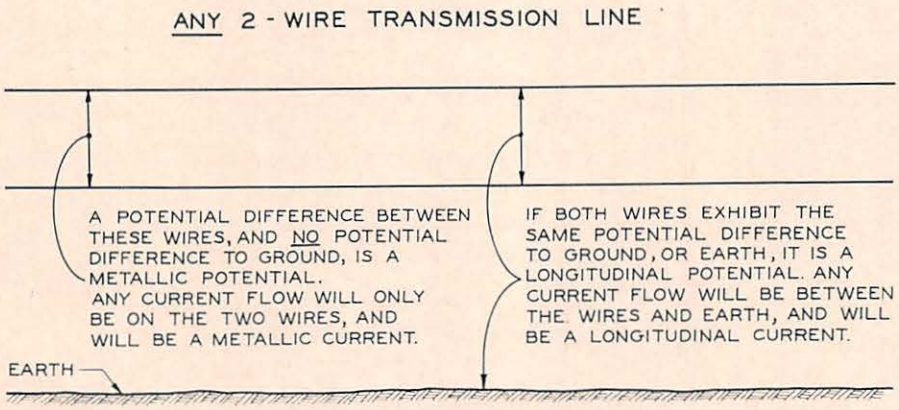
Over-voltage transients can destroy transistors, diodes or solid-state

(Continued from page 24)

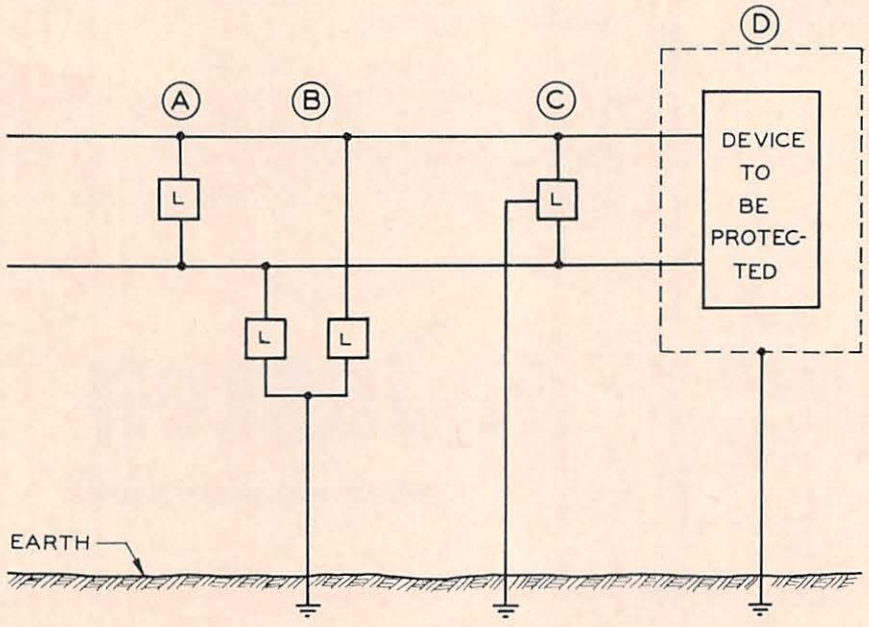
an insulation breakdown between the conducting wires and "earth". It is entirely possible that one pair of wires can pick up both longitudinal and metallic transients at the same time, and from time to time various combinations of voltage, amplitude, and polarity will exist.

The pick up can be from electromagnetic induction of capacitive coupling. In the event of a power line falling down on a wire pair, the transient is directly coupled or connected. The phenomenon to bear in mind is that one wire pair can have a simultaneous metallic and longitudinal transient, and so can the other pair on the crossarms, and they need not be from the same source, or have the same polarity, or the same waveshape.

Figure 2 shows a "device to be protected" installed on a metal rack within a building. Note that the metal rack is "grounded" to the earth. This may be through a cold water pipe system or a direct wire connecting to a conducting rod driven into the earth. The most critical portion is the device connected across the wires. This could be a coupling transformer, a transistorized device with a "blocking" capacitor in series with the input, or any one of several configurations.


ANY 2 - WIRE TRANSMISSION LINE
A POTENTIAL DIFFERENCE BETWEEN THESE WIRES, AND NO POTENTIAL DIFFERENCE TO GROUND, IS A METALLIC POTENTIAL. ANY CURRENT FLOW WILL ONLY BE ON THE TWO WIRES, AND WILL BE A METALLIC CURRENT.
IF BOTH WIRES EXHIBIT THE SAME POTENTIAL DIFFERENCE TO GROUND, OR EARTH, IT IS A LONGITUDINAL POTENTIAL. ANY CURRENT FLOW WILL BE BETWEEN THE WIRES AND EARTH, AND WILL BE A LONGITUDINAL CURRENT.
EARTH

1—Nature of over-voltage transients.



2—Protecting a rack-mounted device in a building.

The device may be working at a signal level input of microvolts, millivolts, or volts. The metallic voltage point at which damage occurs may be very low (a few volts in some devices), and the longitudinal voltage point may be quite a bit higher, sometimes as much as 1,000 volts. One of the outstanding characteristics of "solid-state" is that the transient can destroy the transistor, diode, or rectifier in a few microseconds or less. One other outstanding phenomenon of the over-voltage transient is that it can partially destroy or damage the solid-state devices and so affect the complete unit that transistors and diodes fail at a rapid and continuous rate until most have been replaced. Thus, improper protection can actually result in a worse overall condition than no protection.

In order to keep a metallic transient under control, a protector should be placed from line-to-line as shown in "A" in Figure 2. The scheme shown at "B", which is two protectors from line-to-ground for longitudinal protection, will also give line-to-line (metallic) protection. The protector shown at "C" will give line-to-line and line-to-ground protection, as long as it has a common operating circuit, such as the Joslyn TRI-GUARD protector. The Joslyn 2301-01 VISI-GUARD protector may be used at "A" and "B". (Please note that the "ground" connections shown in Figure 2 are for illustration purposes only).

Figure 3 shows a schematic layout of transient protectors for five incoming pairs of wires. It shows the typical transient arrester layout using 15 protectors to provide both metallic and longitudinal protection.

Please note here that line number 1 protector assembly has its ground in series with all the other arrester grounds. If number 1 protector assembly "fires" in a longitudinal transient, and if the surge impedance of the "ground" wire is not low enough, point "A" can assume a potential of several thousand volts above "ground" (point "B"). Equipment line number 2 may be capacitively at the potential of "B" due to the ground wire from its chassis being returned to "B"; the protectors for number 2 line may fire due to the heavy surge current discharge of number 1, and may cause a metallic or longitudinal transient to appear at the equipment terminals of line number 2, causing damage to it.

The protectors at number 1 will show

devices in microseconds.

a heavy current discharge; those at number 2 will show a light current discharge. Depending on the voltage distribution along the ground wire, etc., the other protectors may also fire.

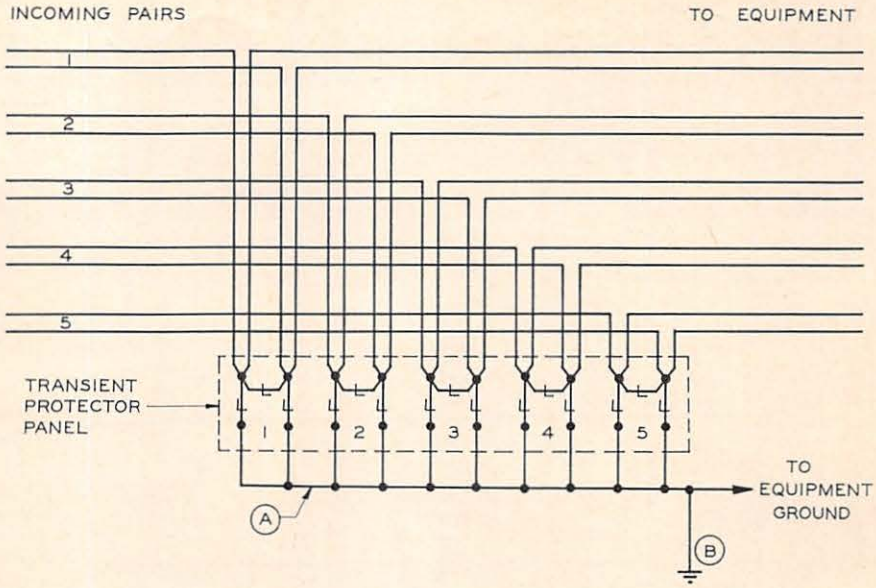
To help prevent the above from happening, the ground connections of the transient protector panel should be rearranged as shown in Figure 4. Grounds and grounding will be a topic of future articles.

The search for the perfect transient protector goes on. Devices that have been used include spark gaps of various kinds, diodes, (silicon, germanium, selenium, copper-oxide), Zener diodes, and silicon controlled rectifiers (SCR's). These have been used singly or in combination with other devices, including resistors, capacitors, and inductors.

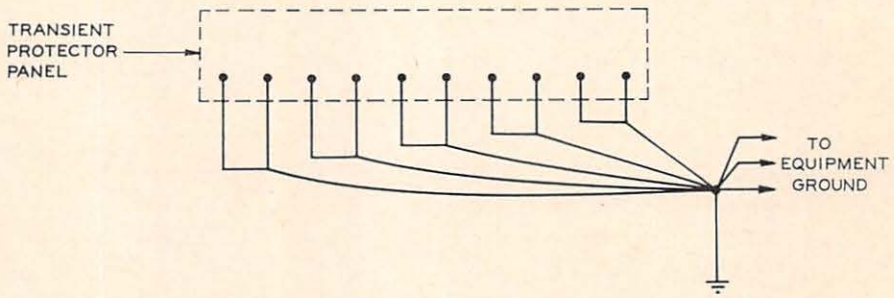
Let us examine the spark gap first. The spark gap, as such, has one outstanding characteristic; that is, it can handle a very large current discharge. If it is correctly designed, it is capable of handling the current discharge of a direct lightning strike, not only the first time, but many times, and without significant change of characteristics.

The open air spark gap using metal or carbon electrodes is no longer useful as a protector as it is not precise or repeatable enough for use on today's circuits. To obtain the precise operation required, spark gaps have been made with a variety of enclosure materials, electrode materials, gaseous atmospheres, and with radioactive isotope prompting. The ideal spark gap should be hermetically sealed, insensitive to light or dark, have no radioactive isotope prompting, fire the first time and every time at the preset voltage point, be a perfect insulator when not conducting, have long life, and "break down" fast when the voltage rate-of-rise is in the order of thousands of volts per microsecond. Another advantage of the hermetically sealed spark gap is that it can be made to reliably break down considerably lower than an open air spark gap.

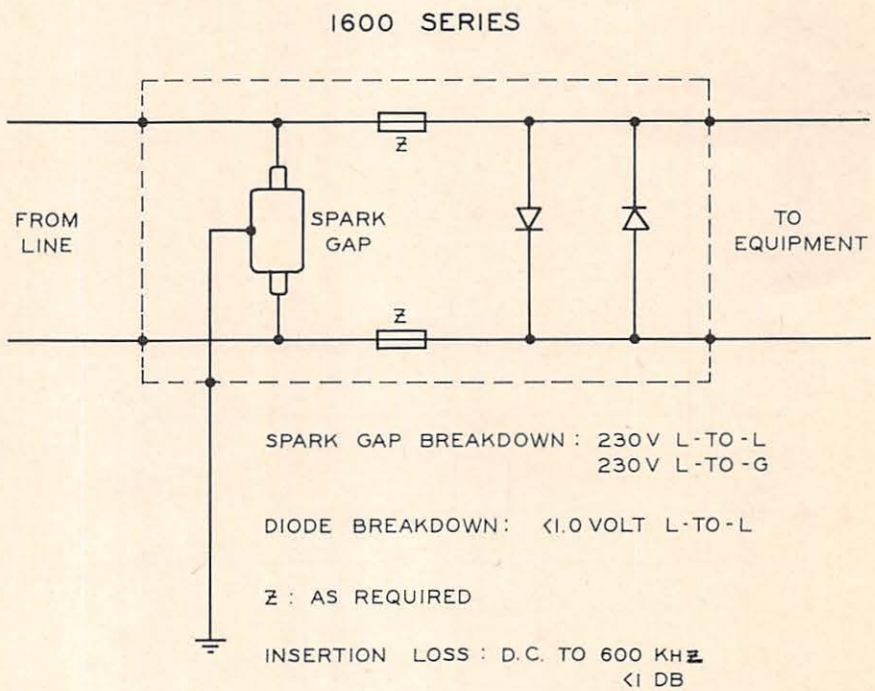
Joslyn hermetically sealed spark gaps, used alone or in Joslyn protectors, are made of high strength, high alumina bodies and pass all the desirable characteristics mentioned. They are the result of extensive research by a team of scientists and engineers who worked exclusively on this project over many years. Spark gaps are usually rated in several parameters, and the most useful ratings for the customer to observe are: DC breakdown, impulse breakdown, current rating, discharge



3—Schematic layout for multi-line transient protectors.



4—Ground connections re-arranged for better protection.



5—Use of 1600 series of protectors for handling transients.

voltage, and estimated life.

It is characteristic that spark gaps break down at a higher voltage than their "spark-over" voltage. The spark-over voltage is the voltage existing across the terminals of the spark gap and is quite stable over a very wide current range. This spark-over voltage is in the order of 40-50 volts and is governed by the gas mixture, electrode

structure, gas pressure, and temperature.

For use as a protection device, the spark gap will be required to be "on location" for periods of time up to years, and still fire correctly when its rated breakdown voltage is exceeded.

For use on circuits used for communications and signaling, the spark gap does not need any special assistance to de-ionize at the end of a transient.

Although spark gaps are very versatile in application, they do not break down low enough to afford the necessary protection for solid state equipment in all applications. Precision, long life spark gaps are not generally available for breakdown below 200 volts, although some manufacturers supply spark gaps of low rating.

To provide a protector with a low breakdown (ie, from models of 1 volt breakdown to 100 or more volts breakdown) it is necessary to use other devices with the spark gap.

For many years, diodes of various kinds have been used to protect the terminal equipment, but invariably failed because of their inherent inability to cope with the excessive current found in some transients. The Joslyn 1600, 1620, and 1630 series of protectors are examples of protectors that combine the best features of diodes, spark gaps, and other components to provide a protector package that is precise, stable, long-lived, and can handle transient discharge currents from a few amperes to many thousands of amperes.

The spark gap used in the 1600 and 1620 series can repeatedly handle 40,000 amp discharge currents (10 x 20 μs waveshape), maintain its breakdown characteristics, and equalize the line. The spark gap used is of the common gas chamber type and affords protection on line-to-line and line-to-ground. The line-to-line breakdown is very low due to the diodes used. See Figure 5.

So far, we have discussed applying spark gaps and spark gap diode combinations to signal and communication lines only. Let us see what is required to use the spark gap as a protector on AC power lines.

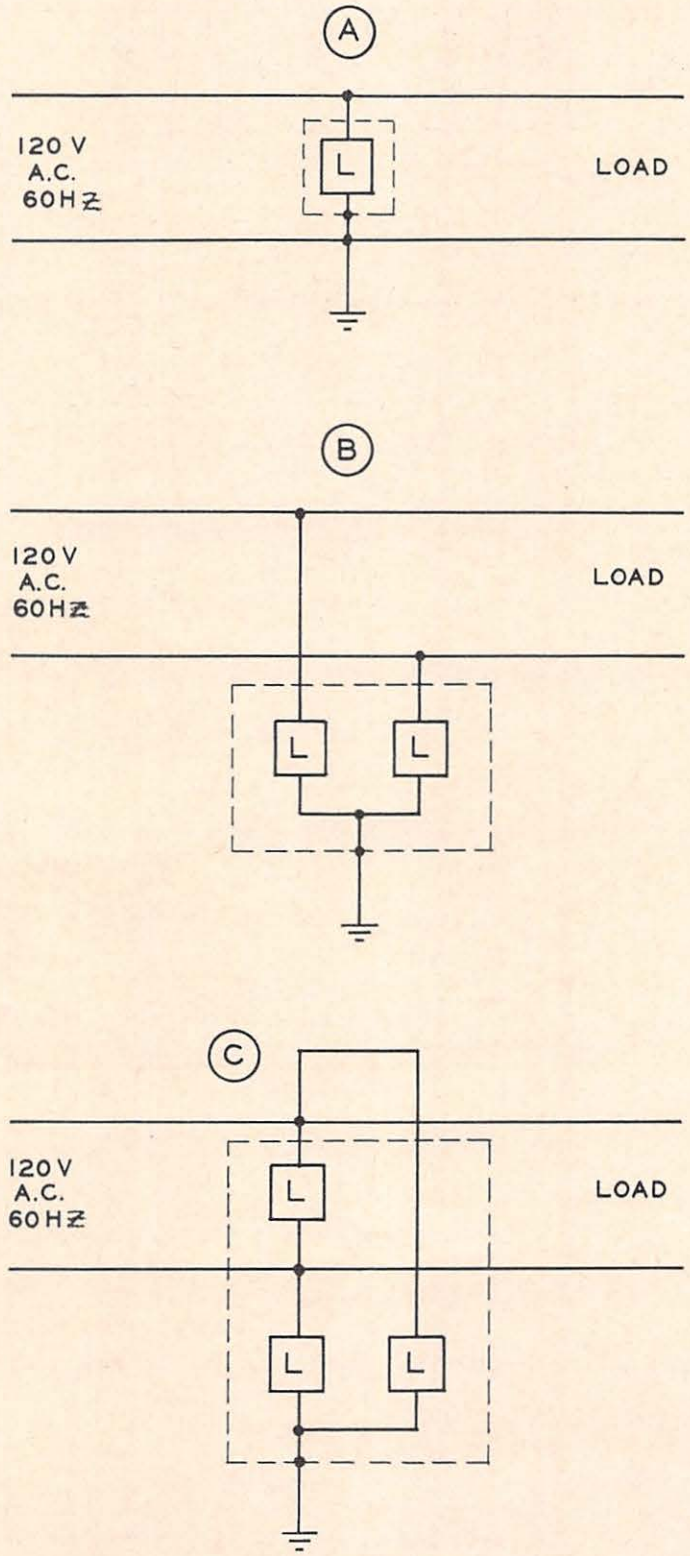
A characteristic of any sparkover arc is that it will sustain itself as long as enough power is available. When using spark gaps on AC or DC power lines, some means must be employed to assure that the arc will extinguish in the face of the "power-follow" phenomenon.

When lightning hits an AC power line, a specially made spark gap allows the lightning to spark it over, rather than to some other part of the system. Due to the circuitry involved, once the arc is struck in the spark gap, the available short circuit current tries to sustain the arc. The lightning has long ceased, but the arc persists and will cause severe damage, so means are provided to blow-out the power-follow arc before damage to electrical equipment can occur.

On Joslyn AC power line protectors, this arc blow-out is invariably accomplished on the first current zero through the protector, which occurs once every half cycle. (This is considerably faster than generally available in most AC power line protectors.) Since the protector is always on the line, it is always protecting.

The Joslyn AC power line protector makes use of an electrode design that

(Please turn to page 30)



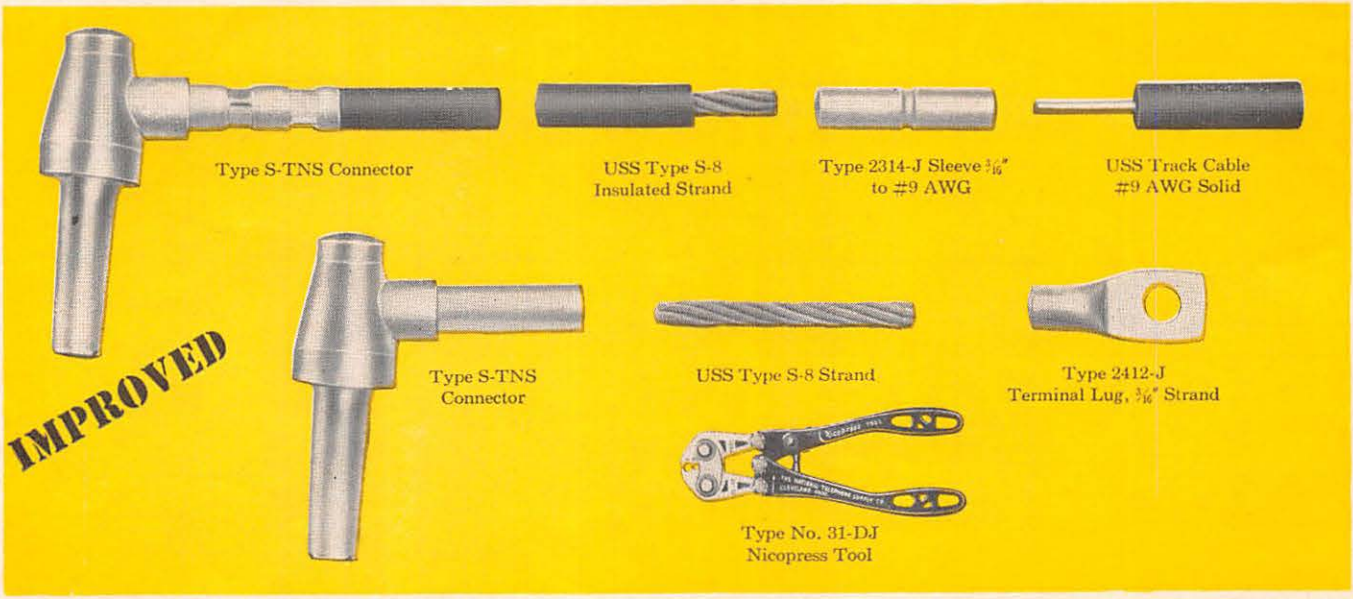
6—Use of AC power line protectors.

Improved track circuit connections with "Do-it-yourself" USS Tiger Brand S-8 Strand and Track Cable

With USS S-8 Strand and USS Track Cable plus the improved fittings illustrated, track connections are now easier to make in the field. Using the "J" groove of the popular 31-DJ Nicopress tool (illustrated), the cable or strand is quickly and positively locked into the fittings—with only two presses.

USS S-8 Strand is available bare in 250-foot coils and 2500-foot reels, and insulated in 100-foot coils and 1000-foot reels. USS Track Cable #9AWG Solid is available in 2000-foot reels. The fittings illustrated below, plus splicing and reducing sleeves for different wire sizes, are all available from United States Steel. If you prefer manufactured signal bonds and connectors, U. S. Steel maintains a complete stock of USS TIGERWELD Rail Bonds.

For more information, contact the United States Steel sales office nearest you, or United States Steel, P. O. Box 86, Pittsburgh, Pennsylvania 15230. Export Distributor: United States Steel International (New York), Inc., P. O. Box 75, New York 10008.


Type S-TNS Connector
USS Type S-8 Insulated Strand
Type 2314-J Sleeve 3/16" to #9 AWG
USS Track Cable #9 AWG Solid
IMPROVED
Type S-TNS Connector
USS Type S-8 Strand
Type 2412-J Terminal Lug, 3/16" Strand
Type No. 31-DJ Nicopress Tool

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USS United States Steel

SURGE PROTECTION

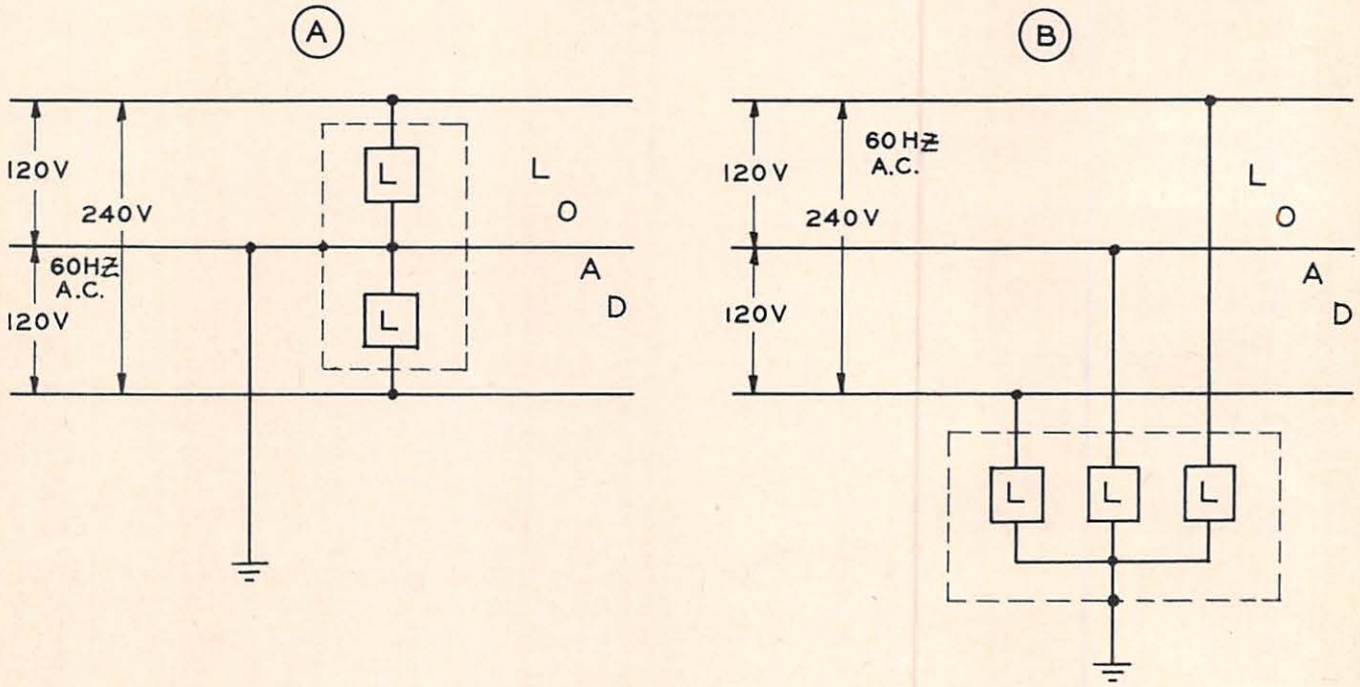
(Continued from page 28)

makes the arc spin around a circular path and by this means handles tens of thousands of amperes of power-follow current.

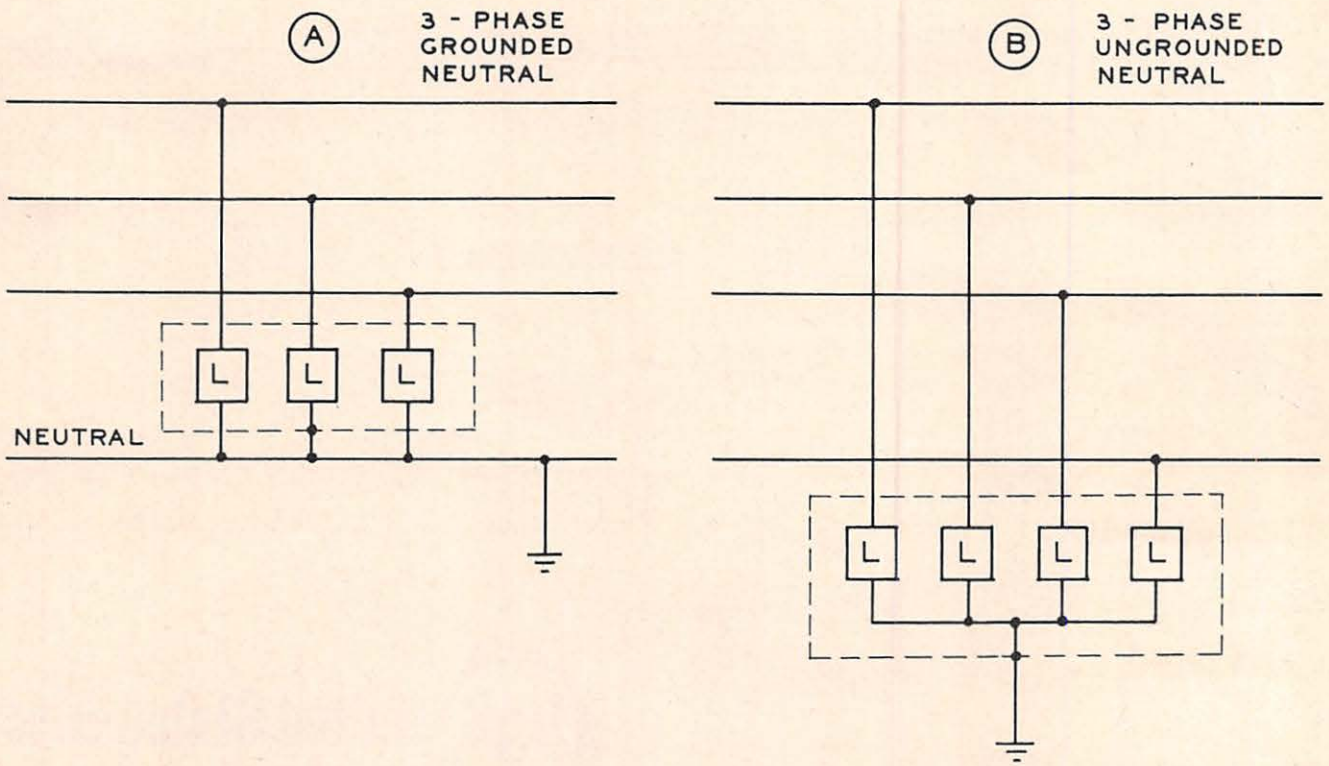
Since it is accepted practice in commercial work to ground one wire of an AC power line, a single-phase protector has only one spark gap. If a single-phase power line is ungrounded, it is necessary to use a minimum of two, but preferrably three, spark gaps to prevent overvoltage transients from damaging equipment connected to the line. See Figure 6, "A", "B", and "C".

A three-wire center-tap grounded 240/120 power system uses two spark gaps if the center wire is grounded, and three spark gaps if not. See Figure 7, "A" and "B".

Three-phase systems use three or four gaps depending upon the ground used or not used. See Figure 8, "A" and "B".



7—AC power line protectors on three-wire 240/120 volt power system.



8—Use of AC power line protectors on three-phase AC systems.

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Start the ball rolling with a call or letter to the Stromberg-Carlson Man-on-the-Scene at Railroad Division, 100 Carlson Road, Rochester, N. Y. 14603. 716-482-2200.

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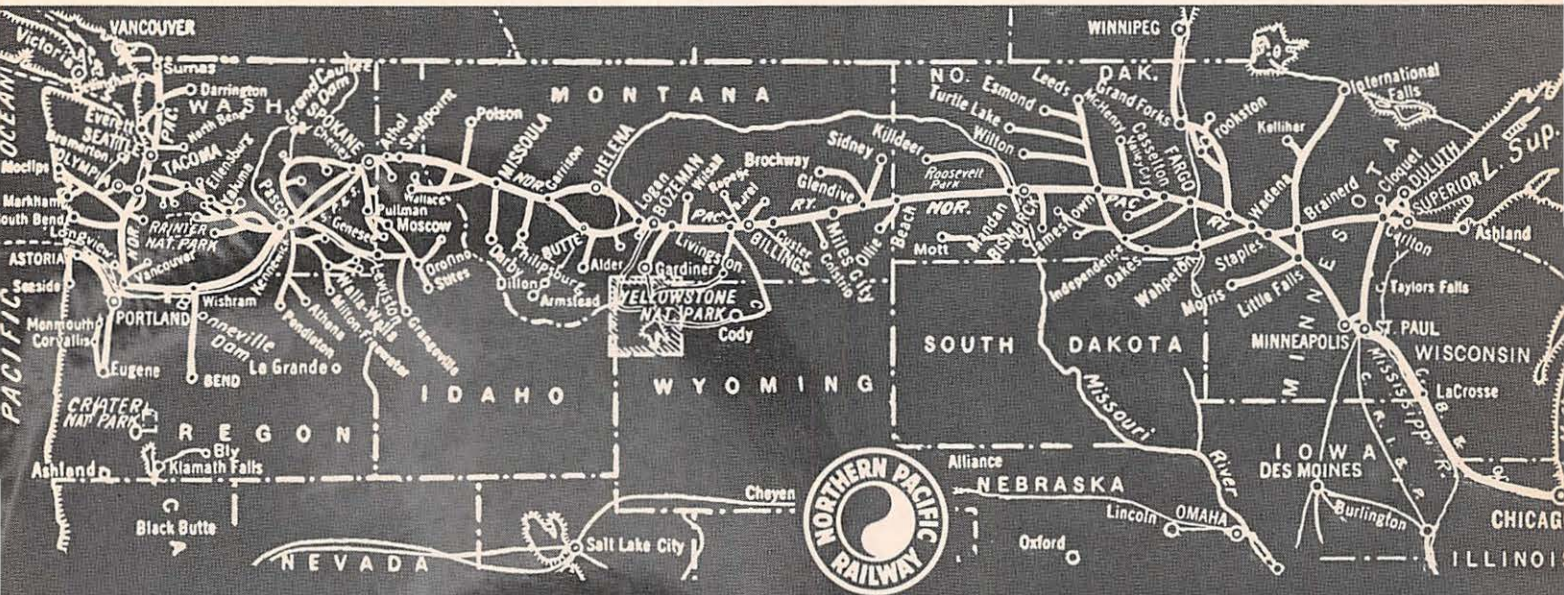

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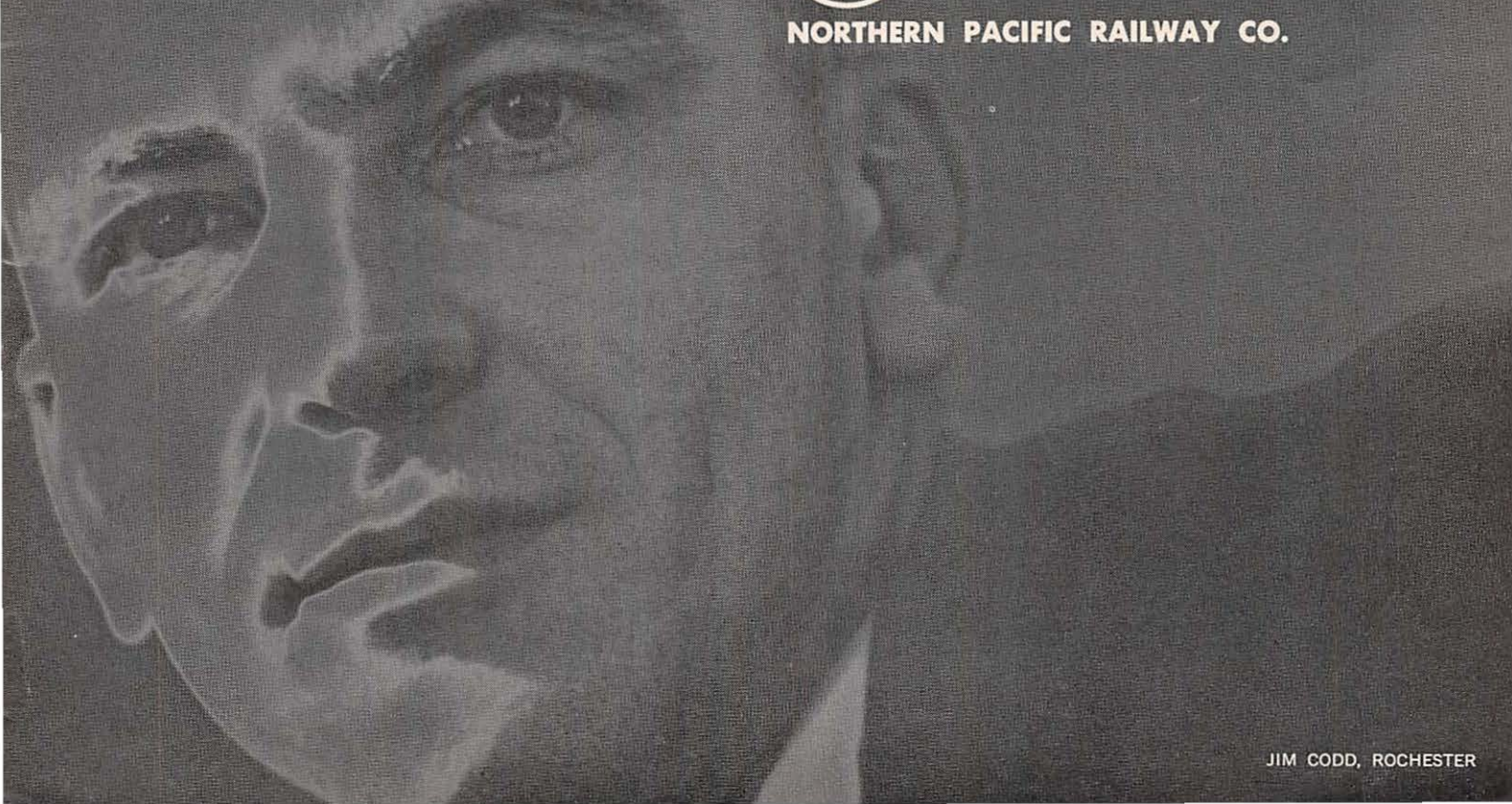

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Circle 13 on reader service card on page 42

Railway Cybernetics

Details of the computerized signal spacing study were described by R. A. Stane, manager-research, AT&SF, at a workshop session at last month's Data Systems Division meeting in Chicago. An abstract of Stane's report follows:

There was suddenly an unprecedented demand for cars of greater sizes, and capacities, operating on competitive schedules conducive to the interests of shippers living with large in-transit inventory investments.

As the freight car was being transformed, power was upgraded and roadways were improved by relocation and closer maintenance. Greater speeds and better schedules with tonnage trains became a physical possibility, providing that signal systems were such that traffic could function both safely and at high density.

The fundamentals involved in bringing a train to a stop have long been understood, but the application of these fundamentals is not in a single manipulation of a few academically sound equations. In fact, the problem of stopping a train must be preceded by the problem of propelling the train to the braking point and, like the stopping problem, train performance is not determined by a single manipulation of pat equations.

Train performance and subsequent braking must be simulated consecutively and each must be treated as a series of individual dynamic events occuring in very small increments of acceleration, distance, and time in an environment peculiar to the immediate problem. If not so considered, the well known basic fundamentals will combine to produce little more than would the use of the "rules of thumb".

The iterative nature of the method of solution decisively removes it from the slide rule and places it squarely on the computer. The Santa Fe met its signal respacing demands through its computer complex having an IBM 360, model 65 as its nucleus.

A program was written by Santa Fe in FORTRAN IV to calculate the performance of trains of any configuration operating over track conforming to actual profiles with all of the pertinent restrictions. The program maintains a running account of the "situation in the cab" so that at any instant a braking point is reached, applicable information regarding speed, throttle position, train resistance, train line air pressure, and current dynamic braking force are available for transfer to a braking program. A braking program was written, also in FORTRAN IV, to accept these initial values and to act upon them precisely as would an engineer and to progressively apply both air and dynamic brakes in accordance with the current braking instructions. Throughout the entire stopping operation, forces are caused to vary internally to be consistent with the track directly under the train throughout its length and train resistance is in continuous controlled transition from initial to zero values. District speeds and board restrictions are observed during the approach to the braking point and beyond.

At the instant of braking, power may be full or partially on; the train may be floating without power or braking effort; speed may be currently sustained with dynamic brakes only or with the help of a light air application. In one situation the train may be bunched and "in hand" but in another situation the train may be stretched out—each requiring an entirely different braking procedure and sometimes producing very surprising but quite correct results, particularly surprising when trains of different configurations are placed in the same environments and it is observed that their comparative efficiencies as braking entities reverse from one situation to another.

The next step was, of course, to develop a modified version of the signal respacing program to perform in much the same manner but to determine the speeds possible over the existing signal system so as to maximize the utilization of the plant during the transition.

The first seven columns of our standard track code sheet, serving our train simulator, are applicable to signal spacing. The first two columns are for engineering stations at each end of a track course which may terminate at a grade break or at the end of a tangent or curve or even possibly at a beginning or end of a speed restriction. The third column is for the gradient of the course. The fourth is for curve compensation (0.04 percent per degree of curvature). The fifth and sixth columns are for speed restrictions due to curves, grades, local ordinances, and so forth. The seventh column is to provide for engineering station equations. The remaining columns pertain to train performance simulations other than those for signal spacing.

Signals may be introduced through coding sheets showing engineers stations of each signal and whether it is capable of a fourth aspect indication.

Trains are introduced through our simulator's standard code sheet.

The signal respacing program (ENSIGN) pertains to signals incapable of the fourth aspect and produces a display which identifies each signal pair by engineering stations and displays the distance between them. After identifying the signal pair, train data is displayed which includes its performance at the instant preceding brake application; the permissible speed and the attained speed, followed by five columns of train configuration statistics. The next items displayed are the distance required to stop and the remaining distance to the signal, if the stop is successful. In the event the stop is not successful, the final column shows where the yellow signal may be relocated to provide the minimum required stopping distance. In the event the signal pair is protected by a preceding fourth aspect signal, a manual observation is made to ascertain as to whether it is sufficiently distant to provide the intended protection.

The traffic optimization program (ENAB) operates in an entirely different mode. It is addressed to maximizing speeds over the existing signal system without change other than the addition of a fourth aspect where needed. It determines the performance of various trains of input configurations over the existing system comprised of signals limited to the third aspect as well as those capable of the fourth.

Signal and train data is displayed in a manner similar to the display of the signal respacing program, however, successful stops are not displayed so that only the exceptions must be manually studied. In the event of a failure to stop at a red signal preceded by only a yellow indication, the number of the yellow signal is given with the maximum speed at which it may be approached by this particular train to successfully stop at the red signal whose identification is also displayed. The speed so indicated at the yellow signal is that which could actually be attained at that point by the train under study.

On receiving a fourth aspect indication, a train is required to reduce speed to 40 mph at the next signal. In the event it is unable to do so, the display will identify the signal set and indicate the maximum speed the train may approach the fourth aspect signal to successfully reduce speed to 40 mph (medium speed) at the next signal.

In the event of a train being unable to stop between the yellow and red signal after having had the benefit of a fourth aspect indication and subsequent control, the signals are identified and passing speeds are displayed to assist the officer responsible for the remedial decision.

The train performance function of the system is not unique in that many railroads are presently making use of dynamic train performance programs. The braking feature, however, is unique in that it too is dynamic as opposed to performing in accordance with data files stored.

Briefly, the braking programs accept certain information from the train simulator at the instant of braking and initiate braking accordingly, using both air and dynamics.

As to reliability on the programs: The train performance simulator has been in constant use since its conception several years ago and has been very successful in duplicating actual train performance under all conditions found on Santa Fe's System.

The braking programs were developed on sound equations and modified empirically to fit actual test train stops and hundreds of dynomometer tests conducted by Westinghouse Air Brake Co., simulating stops under all conceivable conditions.

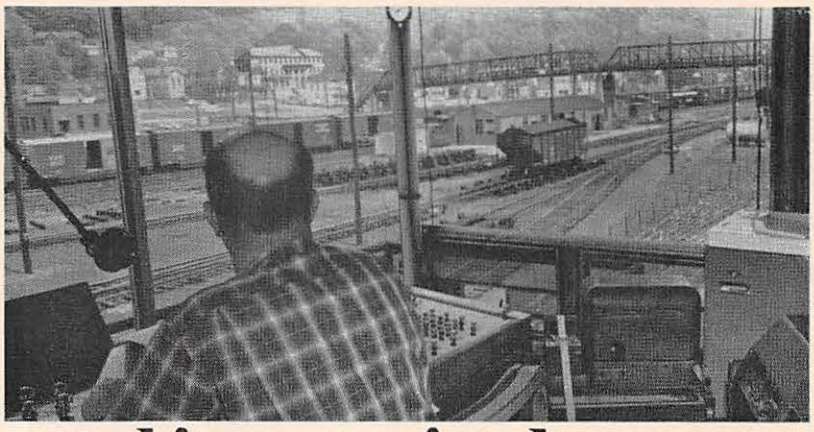
Train performance and braking between each signal pair is simulated over 100,000 ft of track preceding the red signal. The central processor time is approximately one second per signal.

Data Modem Characteristics

Prepared by Leo J. Ritter Staff Engineer, Communications & Signals, Penn Central. Reprinted by permission of George McCann, Secretary, Communication & Signal Section, AAR.

Manufacturer	Bell System	Bell System
Model	303A-20 Data Set	303A-30 Data Set
Transmit and/or receive	Transmit & Receive	Transmit & Receive
Full and/or Half Duplex	Full or Half duplex	Full or Half duplex
Dial up or Private Line Application	Private line	Private line
Turn around time (HDX)	Not applicable	Not applicable
Automatic answer capability	Not applicable	Not applicable
Type modulation	Restored polar sig. conditioning	Restored polar sig. conditioning
Operating Frequencies	1-35 kHz	7-165 kHz
Clock, internal or external	Internal	Internal
Loop back testing feature	Yes	Yes
Error rate	— — —	— — —
Error detection and/or correction	None	None
EIA RS-232-B interface	No	No
Bit or character rate	50,000 bits/sec	230,400 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	135	135
Impedance to data equipment, ohms	90-120	90-120
Voltages to and from data equipment	5 or 23 ma	5 or 23 ma
Frequency stability	— — —	— — —
Level stability	— — —	— — —
Output levels to line, dbm	0	0
Input levels from line, dbm	0	0
Line requirements, frequency response	— — —	— — —
Line requirements, envelope delay	— — —	— — —
Line requirements, impedance	135 ohms	135 ohms
Line requirements, signal to steady noise	— — —	— — —
Line requirements, signal to impulse noise	— — —	— — —
Method of operation	4 wire	4 wire
Temperature and humidity limits	— — —	— — —
Power requirements	140 watts	140 watts
Dimensions and weight	31" x 26½" x 19", 200 lb	31" x 26½" x 19", 200 lb
Digital or analog	Digital	Digital

Keep control!



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The Lynch B770 tone carrier equipment is an ideal combination to be used with the B910B. The B770 is insensitive to noise and phase variations. Reduction of bias distortion and minimization of false operation due to spurious signals are provided by this frequency-shift type of equipment. Reliability is further enhanced by the 35 db (minimum) adjacent channel receive filter rejection which reduces crossfire, crosstalk, and noise to a minimum. The B770 is a superior device for telemetry, telegraph, supervisory control, monitoring and alarm reporting.

Lynch products are easily adaptable to your present or proposed system and are fully compatible with the best industry standards. As with all Lynch equipment, the B770 and the B910B are backed by an undisputed record of top quality and service.

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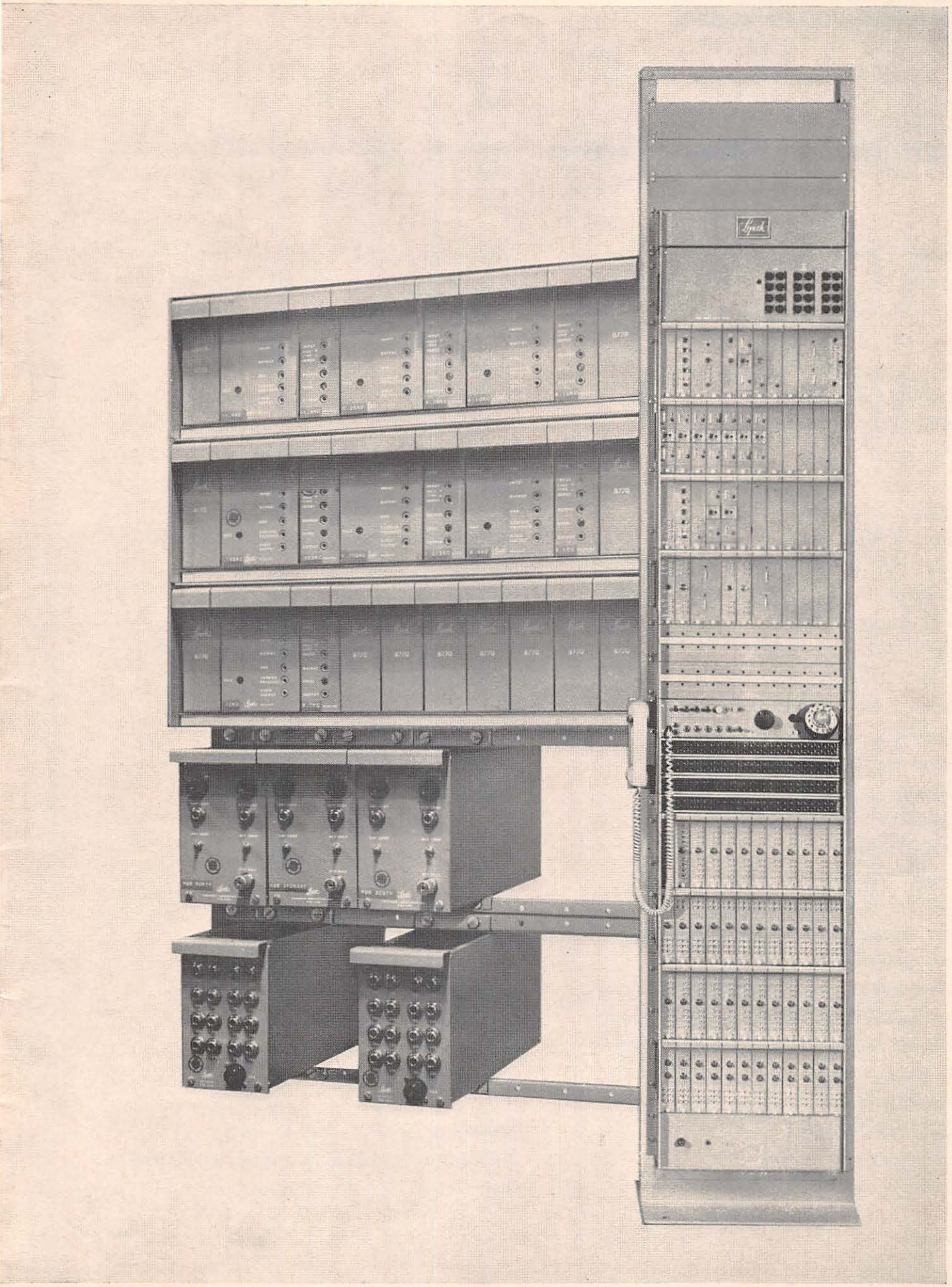

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Data Modem Characteristics

Prepared by Leo J. Ritter Staff Engineer, Communications & Signals, Penn Central. Reprinted by permission of George McCann, Secretary, Communication & Signal Section, AAR

Manufacturer	Bell System	Bell System
Model	303B Data Set	303C Data Set
Transmit and/or receive	Transmit & Receive	Transmit & Receive
Full and/or Half Duplex	Full or Half duplex	Full or Half duplex
Dial up or Private Line Application	Private line	Private line
Turn around time (HDX)	Not applicable	Not applicable
Automatic answer capability	Not applicable	Not applicable
Type modulation	VSB	Restored polar sig conditioning
Operating Frequencies	28-44 kHz	100-36,000 Hz
Clock, internal or external	Internal or External	Internal or External
Loop back testing feature	Yes	Yes
Error rate	— — —	— — —
Error detection and/or correction	None	None
EIA RS-232-B interface	No	No
Bit or character rate	19,200 bits/sec	50,000 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	135	135
Impedance to data equipment, ohms	90-120	90-120
Voltages to and from data equipment	5 or 23 ma	5 or 23 ma
Frequency stability	— — —	— — —
Level stability	— — —	— — —
Output levels to line, dbm	0	0
Input levels from line, dbm	0	0
Line requirements, frequency response	— — —	— — —
Line requirements, envelope delay	— — —	— — —
Line requirements, impedance	135 ohms	135 ohms
Line requirements, signal to steady noise	— — —	— — —
Line requirements, signal to impulse noise	— — —	— — —
Method of operation	4 wire	4 wire
Temperature and humidity limits	— — —	— — —
Power requirements	140 watts	140 watts
Dimensions and weight	24" x 24" x 12", 100 lb	24" x 24" x 12", 100 lb.
Digital or analog	Digital	Digital

View from the Crossarm

Transistor Fundamentals, in four volumes, covers the basics of transistor technology from Ohm's law to digital circuits. The introductory volume in this series is Basic Semiconductors and Circuit Principles, by Robert S. Brite (Training & Retraining, Inc.). This book is a carefully programmed introduction to semiconductors and basic electrical circuits. It begins with a brief description of transistors and later devotes an entire chapter to a detailed explanation of transistor principles. Sandwiched between these chapters are explanations of voltage, current and resistance, and the all important Laws of Ohm and Kirchhoff.

Volume 2 is Basic Transistor Circuits, by Charles A. Pike (Training & Retraining, Inc.). This volume describes transistors and how they are used in semiconductor circuits. Simple circuits illustrate the basic principles involved; more complicated circuits such as found in amplifiers and oscillators help show how the basic operations are applied. Later, some recent semiconductor developments are discussed.

The third volume is Electronic Equipment Circuits by Martin Gersten (Training & Retraining, Inc.). This book covers circuits used in audio, radio and television equipment. The reader is given a basic explanation of block and schematic diagrams and operating principles of input and output devices such as microphones and speakers. Numerous "X-RAY" illustrations highlight the descriptions of these devices. Also discussed are the uses of the oscilloscope, radio-frequency and audio generators and the voltmeter.

Volume 4 is Digital and Special Circuits by Reginald H. Peniston and Louis Schweitzer (Training & Retraining, Inc.). This volume describes how transistorized digital circuits operate. The binary number system is explained so that application of this system in digital circuits can be understood. The test gives a general background of the various digital circuits so that as new, more refined, circuits are developed, the same principles can be applied. Once these circuits are understood, their application in computers, test equipment and tracking and sensing equipment can be easily mastered.

Transistor Fundamentals, Vol. 1 Basic Semiconductors and Circuit Principles (No. 20641) $4.50; Vol. 2 Basic Transistor Circuits (No. 20642) $4.50; Vol. 3 Electronic Equipment Circuits (No. 20643) $4.50; Vol. 4 Digital and Special Circuits (No. 20644) $4.50.

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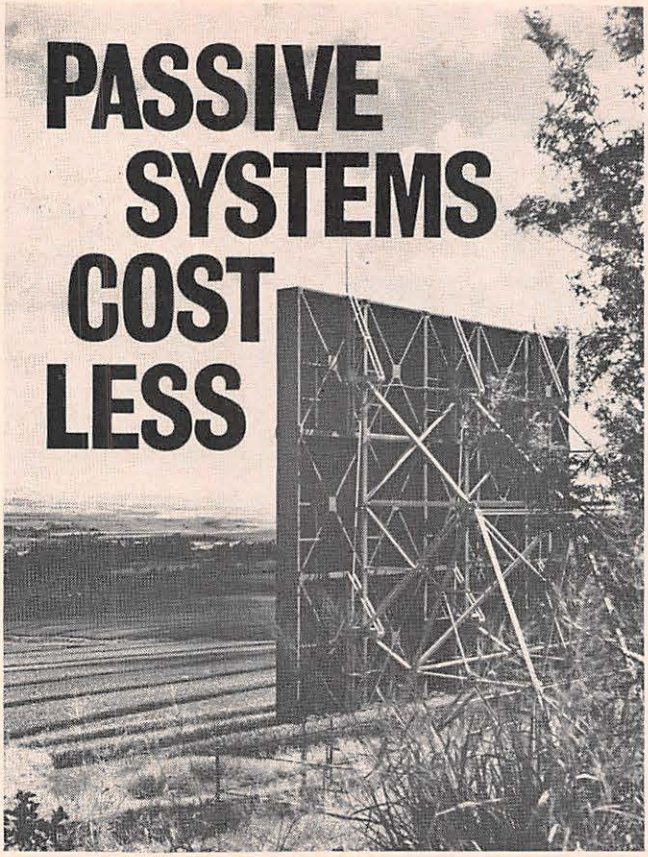

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Retarders
Mechanical
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and electronic operation of
all safety and
signalling equipment.

publiscope

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Product News

Antenna Hat

Safety and greater efficiency, for users of radio remote control systems, is now available in the combination of antenna and hard hat in one unit. The Halo hat antenna provides superior performance to a limp antenna, and comparable to that of a ¼ wave whip. It is designed for longer wearing time, greater range, less loss, and uniform directivity.

Safety is also increased by the low profile, vertically polarized ring radiating antenna that does not extend above the crown of the safety hat. It is available in eight colors and can be sharply tuned to frequencies in either of two ranges: 72-76 mHz and 148-174 mHz. *Signal & Communications Division, WABCO. Circle 101 on Reader Service Card.*

● DATA SET: Bulletin 5301 describes data set T401E which combines a data transmitter telephone set in one housing to provide alternate voice or data operation. The T401E transmits parallel data codes over regular telephone lines at rates up to 20 characters per sec. *Sangamo Electric Co. Circle 102 on Reader Service Coupon.*

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● DATA COMMUNICATIONS: The modern 4400 data sets transmit digital data at rates of 2000 bps, 2400 bps and 4800 bps over unconditioned voice frequency channels. Technical information of the three models of data sets and specialized voice adapters for voice and/or data transmission and transmission test equipment are described in folder 3C8. *Milgo Electronic Corp. Circle 104 on Reader Service Coupon.*

Miniature Reed Relays

The PicoClareed relays represent a state-of-the-art advancement in sealed contact reed relays; they are the fastest and smallest reed-contact relays made. Their response time, physical size, sensitivity, and reliability characteristics combine to give them electrical and packaging compatibility with IC solid-state devices. They have a 500 μs operate time, including bounce, at nominal coil power. For complete compatibility with dual-in-line IC packaging, the relay has a 0.187" low profile mounting and allows for .350 printed circuit board mounting centers. Contacts are hermetically sealed. Terminal leads are gold plated and weldable. *C. P. Clare & Co. Circle 105 on Reader Service Coupon.*

● MICROWAVE: Catalog 15 describes passive repeaters, guyed and self-supporting towers and microwave accessories. The bulletin has photographs as well as design data including physical dimensions and characteristics. *Microwave Systems Co. Circle 106 on Reader Service Coupon.*

Car Retarder

A new electro-pneumatic car retarder is designed to provide increased braking capability with reduced maintenance problems. The model 67 retarder has the same retardation capability when handling 160 ton cars as the model 32 retarder had to control 100 ton cars. Design changes consist of all welded levers, beams and supports, utilizing a corrosion resistant steel. These units are completely interchangeable with the castings used on previous models. *WABCO, Signal & Communications Div. Circle 107 on Reader Service Coupon.*

Relay

A new non-vital relay, the LP-100 is a plug-coupled general purpose relay. Features of the L relay, including length and thickness of the contact springs, contact slide, compression and contact bifurcation have been incorporated in the new relay. It is available in 6 and 8 transfer contacts. Relay coil resistances are standardized for operation at 10, 16 and 24 volts. With standard silver-to-silver contact the LP-100 can handle the same loads as L relays. *WABCO Signal & Communications Div. Circle 108 on Reader Service Coupon.*

● DATA TRANSMISSION: A new 32-page catalog describes microwave radio, multiplex, data transmission and related equipment and includes standard products and services offered by the manufacturer as well as performance information, equipment description and photographs. *Lenkurt Electric Co., Inc. Circle 109 on Reader Service Coupon.*

ASSISTANT SIGNAL ENGINEER

Chicago based railway supply company has opening for Assistant Signal Engineer. Prefer man with five years field signal experience. Position involves engineering and sales.

Send resume to
R. A. Mather, Western Railroad Supply Co.,
2742 W. 36th Place, Chicago, Ill. 60632

Railway Signaling & Communications

14 E. Jackson Blvd., Chicago, Ill. 60604
Attn: R. W. McKnight Reader Service Card 10/68

Circle numbers for more information about products and services.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
47	48	49	50	51	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
142	143	144	145																			

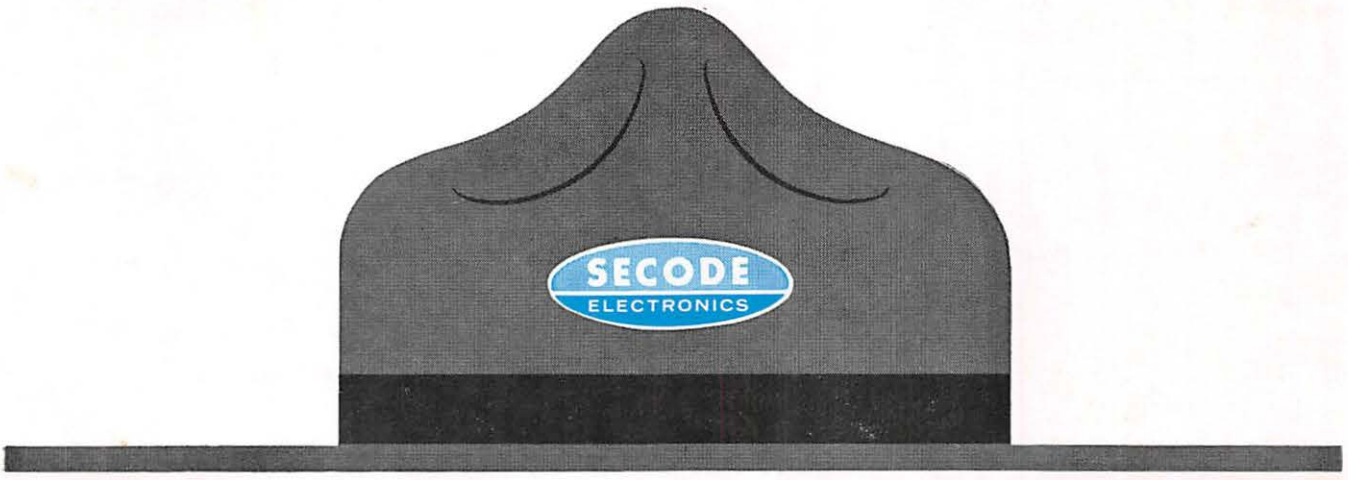
NAME .....

TITLE ..... RAILROAD .....

ADDRESS .....

CITY ..... STATE ..... ZIP # .....

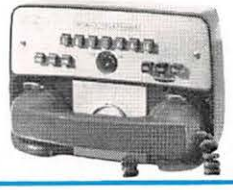
THIS COUPON MUST BE USED ON OR BEFORE DECEMBER 31, 1968



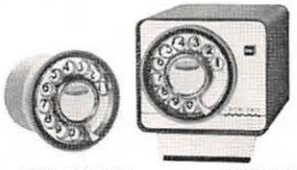
ALWAYS GET YOUR MAN!

Mobile radios are more effective with selective signaling. If the man you seek is on the other end of a 2-way radio, mute his speaker and ring his bell, light his light, honk his horn . . . Secode always gets your man!

Turn off co-channel and intermodulation interference. Block out skip. Get better attention when you need it with a discrete code address digital signaling system by Secode. Let Secode help you get your man — signal us.



VP-1

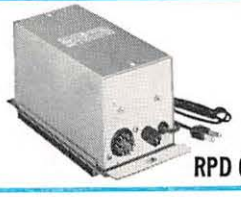


TGS 735 M1 TGS 740

SD-30

MARK 60

SD 2 DS



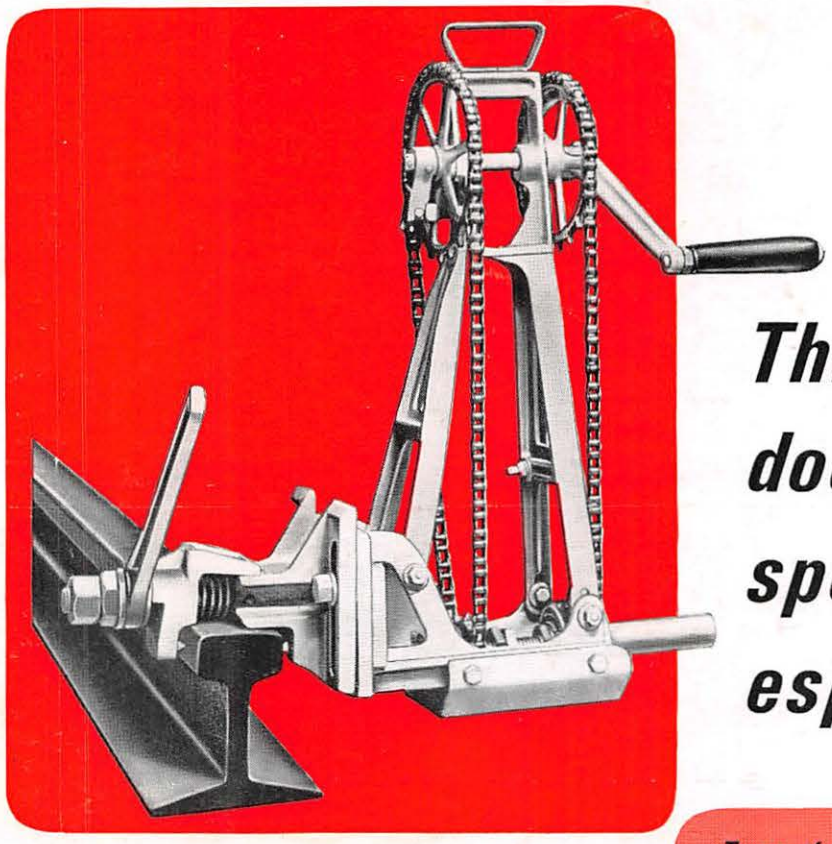
RPD 673

CIH 7A

SECODE
ELECTRONICS

A Division of Communications Industries
908 Dragon Street • Dallas, Texas 75207
Phone 214/742-7231

Circle 2 on reader service card on page 42



This drill does a special job especially well.

THE

WESTERN B-W Bonding Drill

Designed for fast mounting and drilling of bond holes in either head or web of rail, the Western B-W Bonding Drill is light-in-weight and can be operated by one man.

Simple attachment and adjustment features assure ease of operation and accuracy. Depth gauge adjusting nuts provide control for depth of hole required. Special gear reduction system controls positive drilling feed.

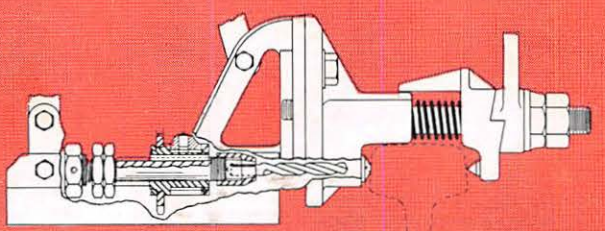
Write for brochure with data on drill bits:

Types of chuck and spindle assemblies available:

ABOVE: Set screw type chuck and spindle for use with Western B-W Bonding Drills. Available in 9/32" and 3/8" flatted shank drill sizes.

BELOW: Hyduty type (not clamp) chuck and spindle for Western B-W Bonding Drill is available in 9/32" and 3/8" flatted shank drill sizes. Specify diameter of drill bit when ordering.

NOTE: A spindle having a collet chuck is also available to handle a standard 3/8" x 3" round shank twist drill bit.



Outline drawing of the clamp mechanism shows the hardened tool steel points inserted in the clamp jaw. These points grip the side of the rail head. No base plate is necessary. This type clamp clears all standard angle bars.

3067

WESTERN RAILROAD SUPPLY COMPANY

Division of Western Industries, Inc.

2742 West 36th Place, Chicago, Illinois 60632

Circle 3 on reader service card on page 42